

# MLS - HEALTH & NUTRITION RESEARCH

<https://www.mlsjournals.com/MLS-Health-Nutrition>



Health & Nutrition  
Research

## How to cite this article

Lasarte, A. (2023). Efecto de la dieta mediterránea en la prevención de la preeclampsia. *MLS Health & Nutrition Research*, 2(1), 83-110

## EFFECT OF THE MEDITERRANEAN DIET ON THE PREVENTION OF PREECLAMPSIA

Álvaro Lasarte García

European University of the Atlantic (Spain)

[lasarte8@gmail.com](mailto:lasarte8@gmail.com) <https://orcid.org/orcid.org/0009-0002-7256-510X>

**Summary.** Introduction: Preeclampsia is a complication with a notorious prevalence nowadays that can be prevented through a healthy lifestyle, in this case, a Mediterranean diet. Objectives: To demonstrate whether an adequate Mediterranean diet can improve maternal health status, in particular, preeclampsia. Material and methods: A literature review was conducted. Eighty-nine bibliographic references were used, using 23 articles taken from Medline, Pubmed and Scielo for the discussion of these concepts, studying 15 of these in depth. Results and discussion: Most of the studies discussed encourage the use of the Mediterranean diet to avoid complications in pregnancy, although most of them have numerous limitations. The role of omega-3 fatty acids, or some micronutrients such as calcium, phosphorus and vitamin D do have a high evidence of benefits in the prevention of pregnancy complications. Conclusions: The Mediterranean diet seems to have ideal health characteristics and can be recommended to pregnant women to prevent preeclampsia and other complications. Even so, more research is needed. What is clear is the importance of a varied and balanced diet.

**Key words:** Mediterranean diet, preeclampsia, benefits, complications, complications

## EFFECTO DE LA DIETA MEDITERRÁNEA EN LA PREVENCIÓN DE LA PREECLAMPSIA

**Resumen.** Introducción: La preeclampsia es una complicación con una prevalencia notoria hoy en día que puede ser prevenida mediante un estilo de vida saludable, en este caso, con una dieta mediterránea. Objetivos: Demostrar si una dieta mediterránea adecuada consigue mejorar el estado de salud materno, en concreto, la preeclampsia. Material y métodos: Se realizó una revisión bibliográfica. Se utilizaron 89 referencias bibliográficas, utilizando 23 artículos sacados de Medline, Pubmed y Scielo para la discusión de estos conceptos, estudiando 15 de estos en profundidad. Resultados y discusión: La mayoría de los estudios discutidos fomentan el uso de la dieta mediterránea para evitar complicaciones en el embarazo,

aunque la gran parte de ellos con numerosas limitaciones. El papel de los ácidos grasos omega 3, o algunos micronutrientes como el calcio, fósforo y vitamina D sí que tienen una alta evidencia de beneficios en la prevención de las complicaciones en el embarazo. Conclusiones: La dieta mediterránea parece tener características idóneas para la salud, pudiéndose recomendar a las gestantes para evitar la preeclampsia y otras complicaciones. Aun así, se requiere más investigación. Lo que se tiene claro es la importancia de una alimentación variada y equilibrada.

**Palabras clave:** Dieta mediterránea, preeclampsia, beneficios, complicaciones

## Introduction

Complications in pregnancy today are still very common, despite having more knowledge compared to past generations. Preeclampsia is one of the major complications that occur in pregnant women and should therefore be investigated (1). There is evidence that it is a problem, above all, in low-income countries with a much improved quality of life (2), like most diseases and complications, with high rates in African-American women with subsequent death of both the fetus and the mother (3). Likewise, the World Health Organization (WHO) estimated that developing countries have a 7 times higher risk of suffering from preeclampsia and it ranges between 2%-10% incidence among pregnancies (5). Another observational study carried out at the Guillermo Díaz de la Vega Regional Hospital, with 1692 participants, shows that 57 pregnant women suffered from preeclampsia during the study, that is, with a prevalence of 3.7%, and this number may be higher in underdeveloped countries (4).

Increasingly, studies and reviews support nutritional treatment as a tool to avoid complications, based on a varied, healthy and balanced diet (6). It could be said that it can be a key tool for both prevention and treatment of its complications. However, this is still under investigation. The Mediterranean diet can be highlighted as a key factor in the control of preeclampsia. Many studies advocate its use for blood pressure reduction, although without specifying the nutritional treatment used (7). Although it may seem that the Mediterranean diet is already well studied, for the moment, there is no scientific clarity on the relationship of this diet and preeclampsia, it is not known exactly if there is a direct benefit due to the Mediterranean diet or to specific components that could also be obtained with other nutritional approaches

The Mediterranean diet has been modified by cultural factors, both in terms of food types and quantities. This is quite a serious problem because of the creation of diet variants that have actually changed from the original diet. In view of the above, this study will address a literature review that will try to clarify whether an adequate Mediterranean diet with a specific nutritional plan is really beneficial enough to prevent or treat preeclampsia, since in recent years its prevalence is increasing markedly and it is urgent to seek measures to solve it.

### 1.1 Target

The general objective of this study is to review the existing literature in order to clarify whether an adequate Mediterranean diet can improve maternal health, particularly preeclampsia. In addition, a series of specific objectives are established:

1.2 Define preeclampsia, its complications and nutritional treatment.

1.3 To establish the pathophysiological mechanisms that cause preeclampsia

1.4 To establish the relationship of micronutrients with preeclampsia

1.5 To explain the role of the Mediterranean diet on preeclampsia and determine its effectiveness

1.2 *Preeclampsia. Definition*

Preeclampsia, also known as EPH-Gestosis, is a very common complication of pregnancy characterized by (2):

- Edemas
- Arterial hypertension
- Proteinuria

These would be the most common conditions, although there may be other problems such as:

- Functional alteration in organs
- Alteration in the growth of the fetus

The trigger for this syndrome is the release of anti-angiogenic markers, causing oxidative stress and a morphological and functional alteration in cells, mainly uterine cells. Among these factors, the most studied are tyrosine kinase-1 (sFlt-1), soluble endoglin (sEng), placental growth factor (PlGF) and vascular endothelial growth factor (VEGF).

A randomized control trial, conducted in Ireland, does not support the incorporation of a PlGF test for the detection or screening of premature preeclampsia, but does not deny its benefits (8). In an ideal or adequate pregnancy, there is a balance between angiogenesis processes (formation of blood vessels) and anti-angiogenic processes (destruction of blood vessels) (9,10).

- According to their severity we can differentiate (11):
- Preeclampsia without severity. It is characterized by a systolic pressure greater than 130 mmHG and a diastolic pressure equal to or greater than 90 mmHG, with proteinuria (excessive protein in urine) but without organ involvement.

Preeclampsia with severity. It is characterized by systolic hypertension equal to or greater than 160 mmHG and diastolic pressure equal to or greater than 110 mmHG, with proteinuria and organ involvement.

**Table 1**

Classification of preeclampsia according to severity. Own elaboration. (11)

Type	Pressure	Proteinuria	Organ involvement
No gravity	Systolic=>130mm HG	Yes	No
	Diastolic=>90mm HG		
With gravity	Systolic=>160mm HG	Yes	Yes
	Diastolic=>110mm HG		

### 1.3 Risk factors, complications and symptoms

Risk factors for preeclampsia are still under discussion, with some being considered certain for this complication.

- Age. Late ages in pregnancy have been associated with an increased risk of preeclampsia. Even so, there are studies (12) that support a high probability of preeclampsia in young women.
- Obesity. It increases VEGF/Flt 1, reducing angiogenesis, thereby producing placental insufficiency and hypoxia (13).

It appears that pregestational BMI may indicate an increased risk of preeclampsia. A person with a high BMI is apparently more likely to have this complication, although as we know the reliability of the BMI is limited depending on the person and their physiological situation. There are studies that do not relate BMI to preeclampsia, as is the case of the meta-analysis and systematic review by Morteza Motedayen et al (14), which found that the mean BMI between women with preeclampsia and healthy women was practically the same.

- Race. African-American women, for example, are at higher risk. In a study conducted at the Hospital General Guasmo Sur in the Guayas Province (country) (15), by means of specific inclusion and exclusion criteria, several characteristics were related to the prevention of preeclampsia. The results showed an increase in the incidence of this disease in black women, which is the first risk factor according to this study.
- First pregnancy. The first pregnancy causes a higher probability of preeclampsia (16).
- Family factors. There is research supporting the relationship of familial inheritance with preeclampsia. Women with mothers who have had preeclampsia have a higher risk of having this syndrome (16).



**Figure 1**  
Distribution of factors associated with preeclampsia (16)

Preeclampsia can cause problems in both the mother and the fetus.

#### *HELLP syndrome*

One of the most common complications following preeclampsia is HELLP syndrome. A disease that causes liver damage and the fracture and rupture of red blood cells (16). An in-depth literature review by Sunita Dubey and Jyotsna Rani (17) concludes that liver damage should be significantly related to hypertensive women, even more so if they suffer from some type of epigastric pain or other symptoms such as pallor or skin discoloration. It is vitally important to monitor both during the gestational and postpartum periods. In addition, laparoscopy and blood transfusions are used as treatment in the case of very advanced stages.

Table 2 below shows the classification of Hellp syndrome according to the Mississippi and Tennessee classification:

**Table 2**

C lass	Mississippi Classification	Tennessee Classification
1	Platelets ≤ 50,000/mL LDH >600 IU/L AST or ALT ≥70 IU/L	Platelets ≤ 100,000/mL LDH ≥ 600 IU/L AST or ALT ≥70 IU/L
2	Platelets > 50,000/mL and ≤ 100,000/mL LDH >600 IU/L AST or ALT ≥70 IU/L	
3	Platelets > 100,000/mL and ≤ 150,000/mL LDH >600 IU/L AST or ALT ≥40 IU/L	

*Severity classification of HELLP syndrome according to the Mississippi criteria (18)*

### *Eclampsia*

Eclampsia is a complication that is often accompanied by preeclampsia. It is the occurrence of seizures or coma during pregnancy after the 20th week of gestation, delivery or in the first hours of the puerperium unrelated to neurological conditions. How to prevent eclampsia in women with preeclampsia through serum magnesium levels is being investigated. A randomized clinical trial conducted by Pascoal (19) divided 62 women into two groups according to the amount of magnesium sulfate administered (1 or 2 g). The results gave an insignificant difference between the 2 groups and also the group with the administration of 1 gram had fewer side effects. There is not much knowledge, at present, on this aspect.

### *Consequences on the fetus*

In the case of the fetus it can occur (20):

- Low birth weight, due to the lack of oxygen and nutrients reaching the baby, resulting in slow growth of the baby.
- Premature birth. Very common in pregnant women who are forced to give birth because of the risk that can occur in both her and her baby.
- Placental abruption. Before giving birth, in many cases, the placenta detaches from the uterus resulting in a lack of oxygen and nutrients. A very common symptom is vaginal bleeding, which usually occurs in mid-pregnancy.
- Kidney failure. Changes in blood flow and glomerular filtration appear to occur in patients with preeclampsia, as well as osmoregulatory and morphological changes of the kidney (21).

### *Depression*

Recent research links possible depression after having suffered from preeclampsia. It is related in a dependent manner and, therefore, care should be taken and care should be taken to try to prevent this type of disorder. A systematic review of 13 studies (22), 8 of which related depression to preeclampsia, showed a possible relationship in most of them. More studies would be needed in this regard, concluding the review by writing that not only is it a risk factor, but it also aggravates the symptoms of this disease in the postpartum period. These hypotheses may be true due to the existence of other articles such as a retrospective cohort study in Edinburgh (23), which concludes a higher rate of postpartum depression after severe preeclampsia (30.77% vs. 14.58%) among preeclamptic women and a control group of women.

Preeclampsia may be asymptomatic, although this is not common. The first sign of preeclampsia is usually increased blood pressure and this can occur slowly or suddenly (the latter is usually less common) (24).

Some of the main symptoms are:

- Nausea
- Reduced urine production
- Low platelet levels
- Changes in vision
- Hypoxia
- Headaches

### *1.4 Nutritional treatment*

There is much controversy about the nutritional treatment that should be used for the prevention of preeclampsia and, progressively, multiple studies are coming to light covering this aspect as they have begun to realize the role of nutrition in this condition. In contrast, there are still recent studies that support the lack of relationship between dietary habits and the prevention of preeclampsia, as in the case of a study at the Faculty of Medical Sciences at the University of Guayaquil (Ecuador) (25), in which they conclude that there is an insufficient relationship between dietary habits and preeclampsia. For this purpose, they made diagrams showing the consumption of

different types of food in the pregestational stage and in the pregnancy period, where a clear relationship between both aspects could not be drawn.

- **Macronutrients**

Dairy products are essential to prevent preeclampsia, without abusing them due to the possible accumulation of saturated fats. Its recommendation is mainly due to fat-soluble vitamins such as vitamin A and vitamin D (25). Fruits and vegetables are extremely important foods for pregnant women because of their fiber intake and because they prevent fluid retention, which can lead to fatal consequences in women (25). As for proteins, they should be of high biological value, not abusing red meat and alternating the consumption of poultry and fish. Oily fish is included for its properties such as omega 3, fats with anti-inflammatory properties (26).

With regard to carbohydrates, it is taken for granted that simple carbohydrates with a high glycemic value, such as industrial pastries, should be excluded from the diet of pregnant women due to the innumerable list of unfavorable consequences they can have. These macronutrients are of great importance for pregnant women. In fact, an analytical case-control study in a hospital in Lima (Peru) in 2019 (26) reflected increased preeclampsia in those who consumed fewer carbohydrates.

As for fats, as will be discussed later, their use as a preventive factor is currently being studied, with some positive and others somewhat contradictory results. Foods should be chosen with an optimum quality and simple cooking methods, avoiding, for example, frying. In high quantities, fats can cause cardiometabolic problems. In fact, a cross-sectional study at the Hospital de Ginecología y Obstetricia del Instituto Materno Infantil del Estado de México (27) shows who have higher cholesterol and triglyceride levels than normotensive individuals without preeclampsia. They conclude by suggesting a lipid profile for women in the gestational period and postpartum.

Referring to the previous study on carbohydrates, they also analyze the role of lipids. Women diagnosed with preeclampsia ingested higher amounts of lipids than the others. Even so, it should be studied in more depth, due to the recent publication of several studies defending the use of fatty acids in this syndrome. According to the study in the Perinatal Perinatal Peruvian journal (26), the risk of preeclampsia is related to carbohydrate consumption in 43.94% with respect to the sample of 102 participants, so it is not really clear the role of carbohydrate specifically for this complication. On the other hand, lipid intake was related to preeclampsia. An intake of more than 1743 kcal of lipids was associated with a 68.97% increase in the chances of contracting preeclampsia; in contrast, 17.81% had no apparent effect on this complication. Both studies were performed with a 95% confidence interval.

- **Micronutrients**

*Folic acid:* it appears that the risk of preeclampsia is reduced with folic acid supplementation. A folate deficiency can induce cell apoptosis, invading the trophoblast and synergistically impairing placental development. The beneficial action of folic acid has been seen with multivitamin supplementation, that is, together with the administration of other vitamins rather than with the administration of this vitamin alone. More studies are needed, but it seems that it may prevent the risk of preeclampsia (28).

### **Table 3**

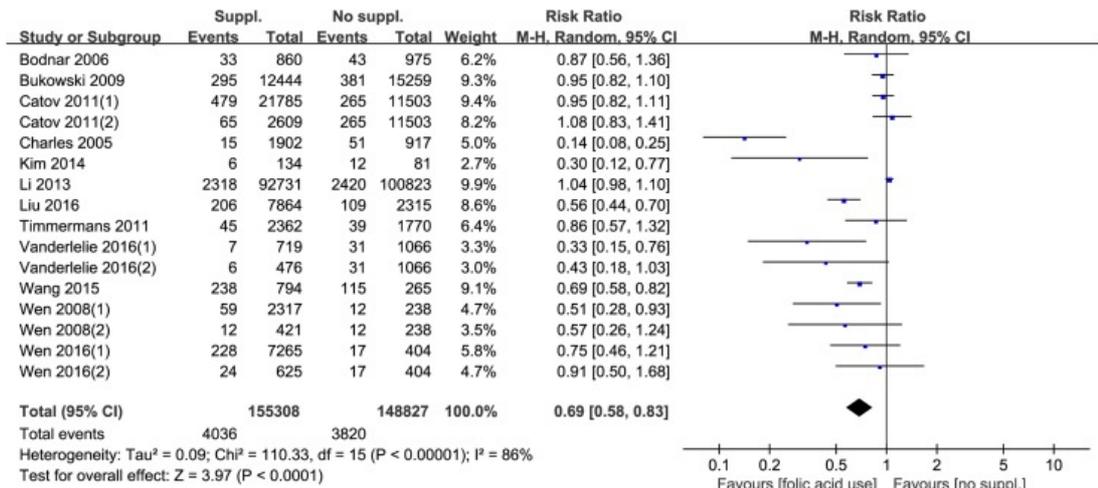


Table showing the relationship of preeclampsia risk with folic acid supplementation in a systematic review published in 2018. The RR (Risk Ratio) of 0.69 indicates a decreased risk with folic acid supplementation (28)

*Vitamin D:* studies have recently been published on vitamin D, a vitamin found mainly in oils, some types of fish, eggs, etc., and its relationship with the prevention of preeclampsia. More evidence is still lacking as it is a relatively new object of study, but everything points to a good correlation with this disease. Vitamin D could be a regulator of blood pressure through the renin-angiotensin system. Research should focus on the appropriate and recommended dose to serve as an incentive for this syndrome. What I have just mentioned is the conclusion of a randomized clinical trial in which a dose of 400 IU and 4000 IU is given to women with vitamin D deficiency and women without deficiency, respectively, with greater benefits in the second group (29). Another important factor could be calcium for the prevention of preeclampsia. Intakes of approximately 1.2-1.5g of calcium per day may reduce the risk of preeclampsia, as supported by numerous reviews (30).

A meta-analysis relating vitamin D, calcium and supplementation of the two together could be found (31) which is summarized in the following Table 4:

**Table 4**

Rango etario (años)	Instituto de Medicina de Estados Unidos			Sociedad de Endocrinología para pacientes con riesgo de deficiencia	
	EAR: Requerimiento promedio estimado (µg / UI)	DRI: Ingestas dietética de referencia (µg / UI)	UL: Nivel máximo de ingesta tolerable (µg / UI)	Requerimiento diario (UI)	Consumo tolerable (UI)
14 - 18	10 / 400	15 / 600	100 / 4.000	600 a 1.000	4.000
19 - 30	10 / 400	15 / 600	100 / 4.000	1.500 a 2.000	10.000
31 - 50	10 / 400	15 / 600	100 / 4.000	1.500 a 2.000	10.000
<b>Interpretación niveles séricos de vitamina D</b>		<b>Unidades convencionales (ng/ml)</b>		<b>Sistema internacional de unidades (nmol/ l)</b>	
<b>Estado</b>					
Deficiencia		<20		<50	
Insuficiencia		21 a 29		52,5 a 72,5	
Suficiencia		>30		>75	
Toxicidad asociada a hipercalcemia		>150		>375	

The recommended intakes of Vitamin D according to the age of the pregnant women are shown (31)

As a conclusion, vitamin D could be preferred because it is a precursor for the maintenance of calcium homeostasis, in addition to being a potent suppressor of renin formation, which is involved in blood pressure (32). Even so, the exact amounts to be

used are still not known and, therefore, much research remains to be done in this regard, adding that there are studies in which vitamin D and preeclampsia have not been assigned any type of relationship (33).

*Copper, magnesium and selenium:* other micronutrients, such as copper, selenium and magnesium, were found to be decreased in a randomized cross-sectional study in pregnant women in southeastern Nigeria, there are more studies linking these micronutrients, but further research is still needed to draw a clear conclusion (34). It seems that it is not so important the type of diet as to have an adequate and balanced level of the different micro and macronutrients, rather than the choice of a specific type of food, being able to be flexible.

### 1.5 Mediterranean diet

The Mediterranean diet (35) is a dietary pattern with multiple proven benefits from countries such as Cyprus, Croatia, Spain, Italy, Morocco and others nearby. It is characterized by the presence of the following foods: high amounts of vegetables, fish, monounsaturated fats (olive oil), fruits, dairy products, meats and avoiding processed products, refined flours, sugars and saturated fats as much as possible. It should be noted that the composition of this diet has changed over the years.

According to the WHO (36) it is an exemplary type of diet if it is carried out together with the execution of physical exercise and the avoidance of unhealthy habits such as tobacco or alcohol. For UNESCO (36) it is declared Intangible Heritage of Humanity, recommending its type of food and, in addition, emphasizing its sustainability, which we will discuss later in a later section. The U.S. Department of Health (37) specified that 3/4 parts of the population did not have conducive and adequate dietary habits to maintain an adequate cardiometabolic status, having micronutrient deficiencies and excess fats and proteins of low biological value.

**Table 5**

Fruits	1-2 meals
Vegetables	>2 meals
Cereals	1-2 servings/meal
Dairy	2 servings per day
Nuts, seeds and legumes	Nuts and seeds 2 or 3 servings per day Legumes $\geq$ 2 servings per week
Beef,pork,ham,lamb	Red meat $<$ 2 servings
Fish, Seafood	$\geq$ 2 servings per week
Sweets	$\leq$ 2 servings per week
Olive oil	1-2 servings per meal
Others	Eggs 2-4 servings per week Potatoes $\leq$ 3 servings per week
Alcohol	Wine in moderation

Number of servings per week of the different foods used in the Mediterranean diet. (38)

### *Inconveniences at the health level*

In specific cases, some variations may occur in biochemical parameters and in the anthropometry of the people who are prepared to follow this type of diet (39).

Weight gain can be very common when using multiple sources of fats, so if special care is not taken it can lead to this consequence. A large percentage of studies agree that, with proper nutritional planning, the Mediterranean diet helps to lose weight and thus to improve different biochemical parameters.

In a randomized controlled trial conducted for the CARDIVEG (Cardiovascular Prevention with Vegetarian Diet) project (40), 2 groups were compared: ovo-lactovegetarian diet and Mediterranean diet in overweight people. The conclusive results were a weight reduction with the two types of diet, in the case of the Mediterranean diet the triglyceride levels decreased more in comparison with the ovo-lactovegetarian diet and in the case of the ovo-lactovegetarian diet the decrease in cholesterol was greater. Recent research (41) is focusing on linking the obesity-associated gene (FTO) to the Mediterranean diet but the results are inconclusive. That said, women should have an adequate weight before and during gestation to avoid associated comorbidities.

Deficiency of some micronutrients, such as calcium or iron, may be present in various cases. The daily consumption of dairy products in Spain is usually below the recommended level. According to AECOSAN (42) (Spanish Agency of Consumption, Food Safety and Nutrition), the ideal would be the consumption of 2-3 servings of dairy products per day, giving great importance to the growth period in children and pregnant women.

**Table 6**

Dairy consumption recommended by the Department of Agriculture, MyPlace Initiative

	<b>Daily recommendation</b>		<b>Equivalences in Spain</b>	
<b>Toddlers</b>	2-3 years	2 cups	480 ml = 2.4 servings	
	4-8 years	2 ½ cups	600 ml = 3 servings	
<b>Girls</b>	9-13 years	3 cups	720 ml = 3.6 servings	
	14-18 years	3 cups	720 ml = 3.6 servings	
<b>Children</b>	9-13 years	3 cups	720 ml = 3.6 servings	
	14-18 years	3 cups	720 ml = 3.6 servings	
<b>Women</b>	19-30 years	3 cups	720 ml = 3.6 servings	
	31-50 years	3 cups	720 ml = 3.6 servings	
	51+ years	3 cups	720 ml = 3.6 servings	
<b>Men</b>	19-30 years	3 cups	720 ml = 3.6 servings	
	31-50 years	3 cups	720 ml = 3.6 servings	
	51+ years	3 cups	720 ml = 3.6 servings	

Recommended daily intake of dairy products at different stages of life (43)

Dairy product supplementation has resulted in significant changes in several cardiovascular and anthropometric aspects as well as in more specific variants such as mood and cognitive functions (44).

In the case of iron, deficiencies are possible if the person's diet is not purely Mediterranean in nature, because he/she should not be deficient in this mineral. In fact, clinical trials in the elderly, such as a one-year randomized trial conducted in Europe through the (NU-AGE) program (45), find that iron status did not change significantly, but did not drop either, and markers of iron status improved considerably.

The culture of alcohol, specifically wine, in this diet, has always been a very controversial issue that has grown in recent years. It is supported that moderate alcohol consumption has a positive effect on the incidence of coronary heart disease. Daily doses of 10 to 30 grams of alcohol are associated with a lower risk of this type of disease. Doses of more than 30 grams of alcohol already have a negative effect according to the WHO (46).

#### *Focus on cardiovascular health*

Leland Allbaugh and Ancel Keys (47) with their Seven Countries study showed that populations eating a Mediterranean diet had lower mortality rates compared to other diets, such as those of Nordic countries. This research marked a before and after and, progressively, clinical trials and cohort studies were carried out to confirm these facts.

What has been seen, additionally, with other diets such as low-fat diets, is a decrease in high blood pressure, positive glucose levels and thus a lower predisposition to suffer from Diabetes Mellitus type 2. As for the lipid profile, the results are more diverse, with improvements in cholesterol and inflammatory markers (48).

In an uncontrolled intervention study carried out in a hospital in Barcelona (49) on patients with ischemic heart disease, in which it was proposed to increase their adherence to a Mediterranean diet in order to verify the changes produced, beneficial results were obtained both in adiposity and cardiovascular health, with an associated improvement of around 20% with respect to cardiovascular risk over the next 5 years. Some of its limitations were: a sample size that was not very significant after the rejection of the participants to the study and the loss of some of them during the course of the study, in addition to the absence of a control group.

In contrast, in a study conducted through the PREDIMED (Prevention with Mediterranean diet) model (50), a prevention trial was conducted on 7,403 participants who were randomly divided into 3 groups. The groups were assigned according to the type of diet: Mediterranean diet with EVOO (extra virgin olive oil), Mediterranean diet with nuts and a control diet. The follow-up period was long and the conclusions were that the use of the Mediterranean diet for the prevention of heart failure could not be stated with certainty (51).

Time is a very important factor and the longer the time, the greater the probability of being able to draw more accurate and objective conclusions. Such is the case of a study carried out in America on firefighters who were assigned to a Mediterranean diet intervention for certain periods of time and it was possible to observe the improvement (although not massive) of cardiovascular and biochemical parameters when this dietary pattern was administered for a longer period of time (52).

### *Environmental sustainability*

Global concern for environmental care has become increasingly evident in the wake of climate events around the world. The Mediterranean diet should be understood as a cultural model, as well as an ecological model (53). In recent years, especially in the last decade, the sustainability of this diet has been studied in depth (54).

The project of Sáez-Almendros S et al (55) aimed to analyze the sustainability of the Mediterranean diet in the Spanish population through: greenhouse gas emissions, agricultural land use, energy consumption and water consumption. Meat and dairy were the major contributors to environmental footprints but their damage to the environment was very small compared to Western diets. The methodology was based on calculating the composition of each food pattern and the footprints of each food.

Spain would reduce all of the above, while a Western diet would increase the parameters by (12% to 72%). The consumption of food in this diet does not mean that undesirable changes in the environment do not occur, but what is evidenced is that it is much less harmful than other types of diets. Various investigations seem to be clear that the reduction of meat and the increase of other products, such as dairy products, eggs, fish and vegetables, help significantly to make a more sustainable diet (56).

### *Possible beneficial effects of the Mediterranean diet in the prevention of preeclampsia.*

Controversy in nutritional topics is the order of the day, as new inventions are discovered or previously established theories are rejected. The same thing happens with preeclampsia. A considerable number of articles of different types (reviews, randomized and controlled trials, books, papers, etc.) show benefits in the use of the Mediterranean diet in the prevention of preeclampsia (57).

### *Overall positive relationship*

In this clinical trial (58), a study was made of the complications that 3 types of diet, including the Mediterranean diet, can cause in pregnancy. Its consumption can be related to a lower risk of hypertension and preeclampsia. It is true that after this intervention some women were diagnosed with preeclampsia, although it is possible that they were already diagnosed with this syndrome before pregnancy, which could constitute a bias in the results.

The review of Argyro Singelaki et al (59), with a massive investigation of articles, concludes that the accompaniment of a diet (most of the studies with a standardized Mediterranean diet) with the accompaniment of physical exercise is a possible preventive method for gestational diseases and complications.

A study in Norway by Assaf Balut (60) review shows that a Mediterranean diet has a lower incidence of preeclampsia in pregnant women, focusing on the importance of adherence to the Mediterranean diet in the pregestational period.

Soltani S et al (61) in their prospective observational study of 812 pregnant women, collecting information through a consumption frequency questionnaire, concluded, objectively, as the results showed, that women with a Western dietary pattern compared to a healthy pattern (as close as possible to the Mediterranean diet) had a more significant association with the possible occurrence of preeclampsia.

Premature infant death, in recent years, has been and is one of the most numerous complications in pregnancy. Nutritional treatment appears to be a key part of preventing these events. In an observational cohort study of women who had delivered preterm, it was observed that women with low adherence to the Mediterranean diet had higher rates of overweight and preeclampsia (62). In contrast, the articles continue to support the idea of a positive relationship between the Mediterranean pattern and preeclampsia, but do not relate it to obesity or hypertension (63).

Therefore, the role of nutrition in the life of the pregnant woman seems to be an important factor, and the Mediterranean diet could be an example of an adequate dietary treatment for an adequate development of the pregnancy and to avoid hypertensive disorders (64). Even so, further studies are required.

#### *Fruit and vegetable consumption and the prevention of preeclampsia*

The Mediterranean diet, in its essence, is characterized by an abundant consumption of fruits and vegetables.

In a systematic review and meta-analysis conducted on hypertension in Ethiopia (65), alcohol consumption and urinary tract infection during pregnancy significantly increased the risk of developing hypertensive disorders of pregnancy. In contrast, pregnant women who obtain nutritional counseling during the prenatal period and consume fruits and vegetables during pregnancy reduce the risk of developing hypertensive disorders of pregnancy and the risk of preeclampsia. These hypotheses are supported by more studies (66, 67).

In the randomized clinical trial conducted at the Carlos III Institute (68), the Mediterranean dietary pattern profile (a Mediterranean diet supplemented with EVOO and pistachios) gave satisfactory results in terms of a lower risk of gestational diabetes, prematurity, urinary tract infections and preeclampsia, compared to a standard diet. Olive oil is the distinctive product of the Mediterranean diet, as are fruits and vegetables (69) that accompany practically all meals in this diet, associating their consumption with lower probabilities of preeclampsia. Some reviews (70) sought to study the effect of fruits and vegetables in pregnant women through vegetable diets and the Mediterranean diet due to its high consumption of these foods, resulting in this dietary pattern being favorable for preventing weight gain and preventing preeclampsia in pregnant women, as well as allergies and dermatitis in infants.

#### *Role of fats (omega 3 acids)*

Omega-3 acids have been studied for their anti-inflammatory and cardiometabolic role in pregnant women. This is particularly important because of the correlation between the Mediterranean diet and this type of fatty acids.

In a meta-analysis published in 2018 (71), through a search in the Cochrane library, it is found that certain studies express the possible reduction of preeclampsia with omega-3 fatty acids, specifically 20 trials supported this hypothesis with a sample size between all of them of about 8,000 participants, even so, they rated it as evidence of a medium quality in terms of reliability.

A review article, published in January 2020 by Bakouei F et al (72), on omega-3 fatty acid intake and its relationship to pregnancy, spoke extensively of omega-3 fatty acid supplementation and increased intake for the prevention of preeclampsia and hypertension, indicating which trials and which meta-analyses supported that

hypertension and the rate of preeclampsia were not significantly reduced in the groups supplemented with omega-3 in high-risk and low-risk pregnancies, mentioning as a possible limitation the size of the sample and the number of trials performed. This last point is a major drawback when it comes to evidencing the role of fatty acids as high quality information, as positive results are being seen, but more support is needed through further research (57).

To finish with fatty acids, it is worth mentioning that both the quality and quantity of these biomolecules is very important. A high amount can lead to complications. A cross-sectional study in which women were recruited by the Department of Obstetrics and Gynecology at the Medical College of Nevada (U.S.A.) and the Department of Obstetrics and Gynecology at the University of Nevada, Nevada School of Medicine (U.S.A.) was conducted. (73), showed that a 1g increase in fat intake compared to the usual recommendations resulted in gestational weight gain and increased metabolic complications in pregnancy.

#### *Inconveniences and limitations of the Mediterranean diet in the prevention of preeclampsia*

In the section on the Mediterranean diet and disadvantages, there is a paragraph dedicated to calcium and its possible deficiency with this type of diet. As already known, the role of calcium in pregnant women is very important to avoid risks to the fetus and the mother herself, affects bone health and is associated with restricted fetal growth and low birth weight. Evidence shows that adequate consumption of dairy products, with a moderate fat content, reduces systolic blood pressure and points to a consequent reduction in preeclampsia (74). Within dairy consumption, milk, especially, would be one of the best dairy products to consume (67). On the other hand, prospective cohort studies, such as that of Carla Assaf Balut (75), see no improvement with low-fat treatment with dairy during pregnancy.

Low levels of calcium in the diet (less than 700 mg) increase the risk of preeclampsia; supplementation of calcium in the diet could reduce the risk by 30% to 50%. WHO (76) recommended that women take calcium supplements to prevent preeclampsia. In-depth reviews on calcium supplementation in periconceptional and conceptional situations, such as the one by Najate Achamrah et al (77), support its supplementation in case the levels of this micronutrient are below the needs of pregnant women.

Regarding supplementation, there is no clear and sufficient evidence on the necessary doses to advise its use. Further research is needed to see if supplementation before and during the first trimester of pregnancy is appropriate to abolish pregnancy complications, including preeclampsia. Likewise, with the systematic review of Hofmeyr GJ et al. conducted in South Africa (78), doses equal to or more than 1 g per day of calcium during the first part of pregnancy could reduce the risks of preeclampsia in pregnant women with diets low in calcium (common in the Mediterranean diet).

As for alcohol, it has always been characteristic of the Mediterranean diet, especially years ago when the effects of excessive consumption were not known. In randomized clinical trials, such as that of Iwama N et al (79) in Japan, the percentage of women who consumed alcohol were at increased risk of preeclampsia and hypertensive disorders. It is important to note that these results were seen with the consumption of more than 150 grams of ethanol per day, an amount well above the current recommendations. Therefore, if it is not consumed in excess, apparently there should not be too many complications

(80). Evidently, the risk will be higher compared to pregnant women who do not consume any alcohol (81).

Among the benefits of the Mediterranean diet with the prevention of preeclampsia, some studies have shown the pros of this pattern with the corresponding disease. There are meta-analyses, such as that of Traoré SS et al (82), which after study analysis support the benefit of the diet, but without knowing by what mechanism or what nutritional factors are most involved, comparing a healthy dietary pattern (where the Mediterranean diet is found) and the Western dietary pattern. Reijnders IF et al (83) in a meta-analysis of observational studies, study proper nutrition and the changes that occur, noting the importance to be given at all stages of pregnancy. An expert review by Marshall NE et al (84) focuses on nutrition before pregnancy, supporting proper nutrition during the periconceptional period as a prevalent factor in complications. Durán A, De la Torre Ng, Assaf Balut C et al (85) also study the Mediterranean dietary pattern and its association with hypertension and preeclampsia. It seems not to have results very much in favor of this relationship.

There are also reviews, such as that of Balut (86), highlighting his projects and research in the periconceptional period with a Mediterranean dietary pattern. Its purpose is to get answers about gestational diabetes, but at the end of the day preeclampsia is present because it is usually a very common complication of diabetes. More studies have been published relating adherence to gestational hypertension and, therefore, to preeclampsia, such as the cross-sectional study of 218 women in the Canary Islands (87). The adherence of their diets to the Mediterranean diet was classified using the PREDIMED model, dividing it into high, medium and low, without showing too many differences.

A meta-analysis by Rogozinska E et al (88) attributes lifestyle changes (here diet would be included), emphasizing the role of physical activity, nutrition would not be the strong point of this study, relating it very little to these complications. Finally, the final search in this section was a randomized clinical trial in 5 maternity units in England (89) to people with metabolic risk factors, giving participants a Mediterranean-style diet. The results were not very positive with respect to the decrease in maternal complications, in general.

## **Method**

This work consists of a bibliographic review, in which, through the support of books, databases, documents, etc., it has been possible to investigate the relationship between the Mediterranean diet and preeclampsia. The search conducted included research studying both the beneficial and harmful or even non-existent relationship of the role of the Mediterranean diet in the prevention of preeclampsia. An attempt was made to prioritize the choice of clinical trials, but the lack of such trials made it necessary to resort to systematic reviews and other articles.

Specific inclusion and exclusion criteria were used: the inclusion criteria used were: studies from indexed journals, an impact factor >1.5, recent research studies (5 years maximum), pregnant women, and articles mostly in English (75%) and the rest in Spanish (25%). The exclusion criteria used include titles that are not related to the topic to be studied, studies with insignificant or non-representative samples, and studies that, although the title may seem appropriate, the information may not be adequate.

The search for items and other complications began in February 2022 and ended in April 2022. The main databases used were:

- 1 Pubmed. Keywords were used in the title and abstract. The Boolean operator "and" was used. Together with Google Academic were the most used databases. About 30 articles from this platform are used.
- 2 Sciencedirect. Keywords were used in the title and abstract. The Boolean operator "and" was used. About 10 articles from this platform are used.
- 3 Google Scholar. Keywords were used in the title and abstract. The Boolean operator "and" was used. About 25 articles from this platform are used.
- 4 Scielo. Keywords were used in the title and abstract. The Boolean operator "and" was used. About 5 items from this platform are used.
- 5 Other sources:
- 6 Internet. A search was carried out, mostly in the initial part of the TFG, in health pages with a notorious quality and evidence.
- 7 Books. 2 books used from the library of the Universidad Europea del Atlántico.

The key words used in this search are very numerous, so the articles used from each database have been mentioned in a general way; moreover, the key words used differ according to the section of the work in question.

**Table 7**

Part of the work	Search strategy	Number of items used	Number of items found	Database and other sources used
<b>Introduction</b>	Preeclampsia, Mediterranean diet and prevention as key words. Using the "and" and 5 years old at the most.	7	350	Pubmed, Science Direct, and various web pages such as WHO
<b>Preeclampsia</b>	Preeclampsia, symptoms, risk factors and nutritional treatment as key words. Using the "and" and 5 years old at the most.	27	130	Pubmed, Science Direct, Scielo, various websites and book
<b>Mediterranean diet</b>	Mediterranean diet, sustainability, cardiovascular effect and prevention as key words. Using the "and" and 5 years old at the most.	22	380	Pubmed, Science Direct, Scielo, various websites and books.
<b>Relationship between Mediterranean diet and preeclampsia</b>	Preeclampsia, Mediterranean diet, advantages and disadvantages as key words. Using the "and" and 5 years old at the most.	23	84	Pubmed, Science Direct, Scielo

Search strategy according to the part of the job. Own elaboration

## Discussion and results

In reference to the efficacy of the Mediterranean diet and the prevention of preeclampsia, there are not many studies that directly relate these concepts, but rather it is more of a secondary objective or result that comes from the study carried out, generally focused on another issue. The studies mentioned above (58-86) support the Mediterranean dietary pattern to not only avoid complications such as preeclampsia, but most of the problems that can take root in this period of gestation. But most of these studies need further investigation (59, 60, 64, 83, 86).

**Table 8**

Authors	Type of study	Efficacy with the Mediterranean diet
Li M, Grewal J, Hinkle SN, Yisahak SF (58)	Randomized clinical trial 24h reminder at 16-22 weeks and 24-29 weeks.	A healthier diet, including the Mediterranean diet (Med Diet), was associated with lower risks of GDM, hypertension and preeclampsia.
Syngelaki A, Sequeira Campos M, Roberge S et al (59)	Bibliographic review through Pubmed, Embase, Cinahl, Web of Science and Cochrane. In the end, 23 trials were selected.	Diet and exercise may improve parameters such as preeclampsia, but more studies are needed.
Assaf Balut (60)	Research Project of the Faculty of Medicine of the Complutense University of Madrid. Bibliographic review.	Obese people with a poor diet are more likely to have complications in pregnancy and a healthy diet (Mediterranean diet) decreases the risk.
Soltani S, Aminianfar A, Hajianfar H et al (61)	In this prospective cohort study, 812 pregnant women aged 20 to 40 years who were in their first trimester were recruited and followed up until 24 to 28 weeks of gestation. The dietary intake of the study subjects was examined using a semiquantitative food frequency questionnaire (FFQ).	The comparison between a healthy diet (as close as possible to the Mediterranean diet) and a Western diet has the benefit of fewer complications (preeclampsia) with respect to the Western diet.
Parlapani E, Agakidis, C, Karagiozoglou-Lampoudi T, et al (62)	Prospective cohort study of 82 pregnant women. A consumption frequency questionnaire was completed and their adherence to the Mediterranean diet was attached.	Women with low adherence to the Mediterranean diet were more likely to have higher rates of complications such as preeclampsia and gestational diabetes. He hypothesizes that it may help prevent it, but it is not obvious.
Minhas A, Hong X, Wang X, Mueller NT. (63)	Cohort trial conducted in Boston on 8507 women of whom 849 developed preeclampsia. Frequency of consumption questionnaires were carried out and different notes on clinical information were taken.	The conclusions are that the Mediterranean style is associated with a lower risk of preeclampsia, but hypertension and obesity are not associated with preeclampsia.
Kibret KT, Chojenta C, Gresham E, et al (64)	It is a systematic review and meta-analysis. A search was conducted in seven databases. The selection of articles was made by 2 reviewers.	Significantly fewer preeclampsia complications were associated with a healthy dietary pattern diet.
Traore SS, Bo Y, Amoah AN, et al (82)	Meta-analysis of observational studies. Literature was searched in Pubmed, Cochrane Library and Web of Science. The choice was made by 2 authors, selecting a total of 12 articles out of 25 observed studies	A healthy dietary pattern (Mediterranean diet) may reduce the risk of preeclampsia, but it would be useful to observe the period of administration as they mention the lack of changes during the 1st and 2nd trimester.

Reijnders IF, Mulders AGMJ, van der Windt M, et al (83)	Systematic review with a search in Pubmed, Cochrane, Web of Science and Google Scholar on lifestyle, tobacco, alcohol, caffeine, nutrition etc.).	An intake following a Mediterranean dietary pattern during the first trimester improves complications during the second and third trimester of pregnancy. More research is needed.
Marshall NE, Abrams B, Barbour LA, et al (84)	Expert review	They focus on the importance of a proper Mediterranean diet before pregnancy to avoid later complications.
Carla Assaf Balut, Alfonso Luis Calle Pascual (86)	Systematic review of several studies on pregnancy complications.	Diverse results on preeclampsia. The articles that were studied in this review gave much importance to the pre-pregnancy period, numerous review articles support the positive effect of the Mediterranean diet especially olive oil and nuts.

Table with the articles that positively relate the Mediterranean diet with preeclampsia. Own elaboration. (58-64, 82-84, 86)

Studies have been found that support the benefit of this diet with preeclampsia such as those included in Table 8, but without specifying what may be the key factor causing this (83). What can be observed, after studying the articles, is a general inability to explain the reasons for these benefits, even though in most cases their effectiveness is demonstrated with data. Therefore, the role, for example, of fats and fruits and vegetables (typical foods of this diet), their characteristics may be beneficial for this, as well as the role of alcohol and calcium and their possible relationship with preeclampsia, were mentioned in the state of the question.

Meta-analysis of maternal patterns and preeclampsia (82) found a relationship between these concepts with an odd ratio (concept used to determine the relationship of 2 variables in statistics) of 0.009, which is a significant result; or the meta-analysis of Kibret KT et al (63), which found a reduction in preeclampsia with higher consumption of fruits and legumes and an odd ratio of 0.0178, and with even lower values in the reduction of other complications such as gestational diabetes. Not only meta-analyses or reviews, but also clinical trials with a fairly large sample size (58), which are the ideal studies in the health area, obtained an odd ratio value of 0.03 in this case. It is also worth mentioning the existence of articles such as the expert review (84), which concludes that a diet guided by a Mediterranean pattern has a lower probability of suffering preeclampsia (based on 4 articles); or others such as the prospective study by Parlapani E, Agakidis, C, Karagiozoglou-Lampoudi T, et al (82) pointing to the Mediterranean diet as an independent and significant predictor of preeclampsia.

Even so, studies such as that of Parlapani E et al (83) did not find significance in high-risk individuals such as hypertensive and obese persons, conclusions in which Minhas A et al (63) also agree; while others, such as the research project of Balut (60), found improvement with diet, precisely in obese persons ( $P=0.0134$ ).

Of vital importance, and still under investigation, is the timing or time period in which diet is effective in the prevention of preeclampsia. There are studies that endorse the periconceptional moment as the key to avoid it, without seeing changes in the diet during pregnancy. As mentioned in the systematic review by Reijnders IF et al (83), future

research should focus on the periconceptional period, thus observing its subsequent impact on pregnancy. Adequate nutrition in the 2nd and 3rd trimester reduces complications, associating less resistance of the uterine and umbilical arteries; and works such as an expert review by Marshall NE et al (84) advocate a healthy dietary pattern consumption before pregnancy, in addition to monitoring and screening methods before pregnancy for the prevention of preeclampsia. These are not the only studies that endorse the timing of study as a key factor. In the gestational period, it appears that low adherence to a DietMed (Mediterranean diet) pattern is not associated with pregnancy-induced hypertension or preeclampsia (85).

Other studies, such as the review by Minhas A et al (63), do not relate obesity to preeclampsia, a conclusion that is surprising, since reviews such as that of Assaf Balut (60), conducted in obese people, had significant rates of developing preeclampsia. After all, a diet is mainly related to health, but this is also reflected in the physical condition of the person at a visual level. These variations are curious since more than one study supports an adequate state of health, precisely before pregnancy, to achieve a lower probability of complications (82,84).

**Table 9**

<b>Authors</b>	<b>Type of study</b>	<b>Effectiveness of the Mediterranean diet</b>
Durán A, De la Torre Ng, Assaf Balut C et al (85)	Prospective single-group intervention study. A total of 1066 were initially recruited, leaving 932 women for the study. Blood tests, anthropometric measurements and nutritional intervention were taken.	In the gestational period, it appears that low adherence to a DietMed pattern is not associated with pregnancy-induced hypertension or preeclampsia.
Tomaino L, Reyes Suárez D, Reyes Domínguez et al (87)	A retrospective cross-sectional study was conducted on a sample of 218 women and their newborns at the Hospital Insular Materno Infantil de Gran Canaria (HIMIGC), Spain. The anthropometric characteristics of the mother were evaluated and adherence to the Mediterranean diet was based on the PREDIMED survey.	No significant results were seen with adherence to the Mediterranean diet in gestational hypertension and preeclampsia.
Rogozińska E, Marlin N, Jackson L, et al (88)	Bibliographic review with searches in MEDLINE, EMBASE and COCHRANE. They focused on the evaluation of weight gain with adverse outcomes through appropriate dietary intervention.	The effect of diet and lifestyle during pregnancy did not show conclusive results in avoiding gestational complications.
H. Al Wattar B, Dodds J, Placzek A, et al (89)	Multicenter randomized trial in 5 maternity units in different hospitals in England. A control group and a Mediterranean diet intervention group were assigned to 593 women.	No changes were seen in the rates of complications such as preeclampsia, small fetus or admission to the neonatal care unit.

Table on articles that do not positively relate the Mediterranean diet to preeclampsia. Own elaboration. (85,87 ,88 ,89)

There are 4 studies that support the lack of efficacy of the Mediterranean diet (1 cross-sectional study, 1 clinical trial, 1 systematic review and 1 prospective study). Findings, such as that of Rogozińska EE et al (88), relate adequate diet and active lifestyle to gestational weight, but not to complications such as hypertension, preeclampsia, or diabetes. On the other hand, Durán A et al (85), in their prospective study did not see

differences in hypertension or preeclampsia in diets with low adherence to the Mediterranean diet (odd ratio of 0.8), in contrast to gestational diabetes in which they see significance, with olive oil fats as a possible trigger. The others do not put much emphasis on preeclampsia as they cover many outcomes in the study, but in the overall results a nonsignificant difference can be observed with the Mediterranean diet (87, 89).

In the multicenter trial conducted in England (89), not only were no differences seen with preeclampsia, but no differences were seen with any other complication, except for gestational weight (odd ratio = 0.54) and gestational diabetes (odd ratio = 0.67), with no significant results. Negative results were also found in the case of the cross-sectional study carried out at the Hospital in the Canary Islands (87). Adherence to the Mediterranean diet with the risk of preeclampsia was not significant with a value of ( $p=0.2$ ); even higher values were found in the review by Rogozinska et al (88) with values of ( $p=0.96-1.16$ ).

More than the type of diet, much importance is given to specific micronutrients to prevent preeclampsia. After an in-depth study, it appears that folic acid and vitamin D are very important in controlling this disease. Folic acid, a major constituent of fruits and vegetables, plays a very important role in preeclamptic cells (29). Their role seems to go further and they find improvements in the prevention of urinary tract infections, fetal maldevelopment and prevention of some allergies (66-71).

With vitamin D and calcium there is sufficient certainty, through numerous studies, of their benefits in pregnant women to prevent bone weakness, fetal alterations and hypertensive disorders, among others (68, 75-77). What would remain to be resolved would be whether supplementation is necessary, as stated by the WHO (77), or whether it is only necessary in the case of not ingesting adequate amounts daily for different reasons, and thus what daily amounts would be necessary (78) and whether they should be increased or not (30).

We must not forget to mention the role of EVOO (Extra Virgin Olive Oil), a differentiating attribute of the Mediterranean diet. It seems that omega-3 fatty acid has great benefits in preeclampsia, but more research is still needed to know the adequate doses and studies with more precise methodologies (58, 72-74). Lastly, and no less characteristic of the Mediterranean diet, alcohol should be considered. Its consumption can cause complications for the woman and the baby. In the recommended daily amounts there would be no major inconvenience, but if consumption could be avoided it would be best (79-81).

Studies such as that of Mengying Li et al (58) or the prospective study by Soltani et al (61) use a 24-hour recall, which may lead to an inadequate relationship between what is consumed and what is captured in these recalls. The MEDAS protocol, used to assess adherence to the Mediterranean diet, as mentioned in the prospective study carried out in the Hospital Canario (87), does not provide exhaustive information on the quality of the diet and the calories it provides.

The existence of clinical trials has been somewhat scarce, only 2 trials (58,89) with some scientific evidence. Trials are very scarce in this area and have limitations such as small sample numbers or a methodology that could be improved. It would be necessary to add the commitment of the participants, as is the case of the randomized clinical trial by Traoré SS, Bo Y, Amoah AN et al (88), in which they mention that they only knew the dietary intake of about 40% of the study population. In general, both clinical trials

and cohort or intervention studies have a considerable sample size, giving rise to greater evidence and objectivity when assessing the results (58, 61-63, 85, 89).

Another limitation that can be added in the discussion of these studies is the different pathological situation of the persons studied. The project carried out by Balut (60) focused on obese people; the study by Soltani S, Aminianfar A, Hajianfar H et al (61) excluding women smokers; the multicenter clinical trial carried out in 5 maternal units in England (89) on women with cardiovascular conditions and, in addition, of different races and other pathologies such as obesity; or the prospective study by Durán de La Torre (85) with diabetic people. These differences in the way research is conducted can be a key factor in relating the different results that are produced.

The type of diet and its characteristics are a subject of discussion in the literature. In fact, some of the researches speak of a healthy dietary pattern (62, 64, 82), mentioning the properties of the diet very similar to the Mediterranean diet, but without dubbing it with the name "Mediterranean diet". Neither are the same amounts and portions of food used, so it is difficult to objectively compare studies, for example, using a diet heavily focused on EVOO and nut consumption (89). While others, directly (60, 88), focus on the concept of diet, in general, without specifying.

To conclude with the limitations, the studies presented may not have the fame or prestige that other journals or databases may have. For example, the study by Assaf Balut (60) conducted by the Universidad Complutense de Madrid, or the randomized clinical trial by Mengying et al (58) conducted by a small group of people who did not have a transcendental background in this field, which does not mean that their results should be belittled or treated as invalid. Some of the articles found belong to final degree works, university works or, for example, works from different hospitals, as in the case of the Hospital del Sur de Guayas (Peru) (15).

Summarizing, of all the articles that directly relate the concepts of preeclampsia and Mediterranean diet, 4 studies are found that do not support or do not support these concepts and would be (85, 87-89), while the studies that support their benefit, in total 11, would be (58-64, 82-84, 86).

### **Conclusions**

To conclude, emphasizing the studies that relate preeclampsia to the Mediterranean diet, there is a greater number of articles that directly support this relationship. In general terms, the Mediterranean diet can be recommended to avoid complications in pregnancy, such as preeclampsia. It is true, as has been mentioned in the discussion, that there is a lack of articles specifying the mechanisms that produce these benefits in the prevention of preeclampsia, as well as the lack of certainty of its benefit in healthy individuals only, or also in individuals with pathologies.

Processed foods, excessive fats, refined sugars and other unhealthy products are not suitable for this stage of life or any other, due to their pro-inflammatory effects, as well as metabolic and cardiovascular disorders. In this study, an attempt has been made to clarify the objectives that were proposed at the beginning. All the general aspects related to preeclampsia have been discussed, both complications and pathophysiological mechanisms, as well as the role of nutrition in the disease. As with the Mediterranean diet, its characteristics, its cardiovascular approach and its relationship with preeclampsia have been studied. Complications from preeclampsia can be very dangerous for maternal and fetal health, explaining the optimal nutrients for the prevention of preeclampsia.

After a thorough search, we can conclude the importance of certain macro and micronutrients, which can also be provided by diets other than the Mediterranean diet. It is easier to focus on a micro or macronutrient than on a diet in general, because it is much more difficult to draw conclusions as to what has been the triggering factor due to the diversity of variables to be taken into account if we consider a diet in a broad sense. Consequently, we do not claim that this is the ideal and only dietary pattern to be used in pregnancy, since studies have shown that using other types of diets there is also an improvement.

It should be emphasized, as mentioned in the status of the question, that preeclampsia and its development is multifactorial and that an adequate diet can interfere in one way or another depending on the race, the number of pregnancies of the pregnant woman and other characteristics. Finding good studies, as well as conducting them, is a very complicated task due to the many variables to be taken into account. An adequate state of health will help most of the time to minimize the risk of all kinds of diseases, in particular, food and, in this case, the Mediterranean diet, can abolish cardiovascular and metabolic complications.

### **Bibliographic References**

- (1) Muñoz Solorzano LDR, Alvarado Franco HJ, Alvarado Muñoz RN, Alvarado Muñoz BJ. Preeclampsia: Complicación durante el embarazo que se puede prevenir. *Sci Rev Prod Sci E Investig.* jan 30, 2020; 4 (30): 72-6.
- (2) Filipek A, Jurewicz E. Preeclampsia - a disease of pregnant women. *Postepy Biochem.* dec 29, 2018; 64 (4): 232-229.
- (3) Zhang M, Wan P, Ng K, Singh K, Cheng TH, Velickovic I, et al. Preeclampsia Among African American Pregnant Women: An Update on Prevalence, Complications, Etiology, and Biomarkers. *Obstet Gynecol Surv.* Feb 2020; 75(2): 111-20.
- (4) Mamani Mamani HF. Prevalencia y factores de riesgo para preeclampsia en gestantes - Hospital Regional Guillermo Díaz de la Vega de Abancay, 2019. *Univ Nac Altiplano [Internet].* september 3, 2020 [cited March 11, 2022]; Available from: <http://repositorio.unap.edu.pe/handle/UNAP/13802>.
- (5) Jesús-García AD, Jimenez-Baez MV, González-Ortiz DG, Kuc-Peña LM. Características clínicas, epidemiológicas y riesgo obstétrico de pacientes con preeclampsia-eclampsia.: 7.
- (6) Hajianfar H, Esmailzadeh A, Feizi A, Shahshahan Z, Azadbakht L. The Association Between Major Dietary Patterns and Pregnancy-related Complications. *Arch Iran Med.* october 1, 2018; 21 (10): 443-51.
- (7) Lokeswara AW, Hiksas R, Irwinda R, Wibowo N. Preeclampsia: From Cellular Wellness to Inappropriate Cell Death, and the Roles of Nutrition. *Front Cell Dev Biol.* november 5, 2021; 9: 726513.
- (8) La Preeclampsia y sus hipótesis - *Revista Electrónica de PortalesMedicos.com [Internet].* [cited Mar 23, 2022]. Available from: <https://www.portalesmedicos.com/publicaciones/articulos/226/1/La-Preeclampsia-y-sus-hipotesis.html>
- (9) Ives CW, Sinkey R, Rajapreyar I, Tita ATN, Oparil S. Preeclampsia-Pathophysiology and Clinical Presentations: JACC State-of-the-Art Review. *J Am Coll Cardiol.* oct. 6, 2020; 76 (14): 1690-702.
- (10) Factores angiogénicos y antiangiogénicos en la preeclampsia - *Revista Electrónica de Portales Medicos.com [Internet].* [cited Mar 11, 2022]. Available from:

<https://www.revista-portalesmedicos.com/revista-medica/factores-angiogenicos-y-antiangiogenicos-en-la-preeclampsia/>

(11) Rojas Pérez LA, Villagómez Vega MD, Rojas Cruz AE, Rojas Cruz AE, Rojas Pérez LA, Villagómez Vega MD, et al. Preeclampsia - eclampsia diagnóstico y tratamiento. Rev Eugenio Espejo. December 2019; 13 (2): 79-91.

(12) Ortiz Martínez RA, Otalora Perdomo MF, Delgado ABM, Luna Solarte DA, Ortiz Martínez RA, Otalora Perdomo MF, et al. Adolescencia como factor de riesgo para complicaciones maternas y neonatales. Rev Chil Obstet Ginecol. Nov 2018; 83 (5): 478-86.

(13) Howell KR, Powell TL. Effects of maternal obesity on placental function and fetal development. Reprod Camb Engl. Mar. 2017;153 (3): R97-108.

(14) Motedayen M, Rafiei M, Rezaei Tavirani M, Sayehmiri K, Dousti M. La relación entre el índice de masa corporal y la preeclampsia: una revisión sistemática y un metanálisis. Int J Reprod Biomed. July 31, 2019;17(7):463-472.

(15) Clemente Balón ML, Tomalá Parrales LJ. Factores predisponentes que influyen en la preeclampsia en gestantes atendidas en el Hospital General Guasmo Sur. 2019. november 30, 2020 [cited May 18, 2022]; Available from: <https://repositorio.upse.edu.ec/handle/46000/5562>

(16) Rodriguez LLM, Ramirez AJE, Yamunaque YAT, Ramos KLC. Preeclampsia severa y sus complicaciones a propósito de un caso. Recimundo Rev Científica Investig El Conocimiento. 2020; 4 (4): 343-52.

(17) Dubey S, Rani J. "Hepatic rupture in preeclampsia and HELLP syndrome: A catastrophic presentation". Taiwan J Obstet Gynecol. Sep 1, 2020; 59 (5): 643-51.

(18) Sanchez ACA, Steller SK, Mendez DP, Garita JR, Garita FS. Actualización y conceptos claves del Síndrome de HELLP. Rev Cienc Salud Integrando Conoc. June 1, 2020; 4 (3): 65-75.

(19) Ana C F Pascoal 1, Leila Katz, Marcela H Pinto, Carina A Santos, Luana C O Braga, Sabina B Maia, Melania M R Amorim. Serum magnesium levels during magnesium sulfate infusion at 1 gram/hour versus 2 grams/hour as a maintenance dose to prevent eclampsia in women with severe preeclampsia: A randomized clinical trial - PubMed [Internet]. [cited Mar 11, 2022]. Available from: <https://pubmed.ncbi.nlm.nih.gov/31393402/>

(20) ¿Cuáles son los riesgos de la preeclampsia y la eclampsia para el feto? [Internet]. <https://espanol.nichd.nih.gov/>. [cited Mar 11, 2022]. Available from: <https://espanol.nichd.nih.gov/salud/temas/preeclampsia/informacion/riesgos-feto>

(21) Wiles K, Stillman IE, Conrad KP. Chapter 14 - The Kidney in Normal Pregnancy and Preeclampsia. In: Taylor RN, Conrad KP, Davidge ST, Staff AC, Roberts JM, editors. Chesley's Hypertensive Disorders in Pregnancy (Fifth Edition) [Internet]. Academic Press; 2022 [cited 2022 May 25, 2022]. p. 289-334. Available from: <https://www.sciencedirect.com/science/article/pii/B9780128184172000099>

(22) Caropreso L, de Azevedo Cardoso T, Eltayeb Ani M, Frey BN. Preeclampsia como factor de riesgo para la depresión posparto y la psicosis: una revisión sistemática y un metanálisis. Arch Womens Ment Health. 2020 Aug; 23 (4): 493-505. Epub 2019 Dec 4. PMID: 31802249.

(23) Ye Y, Chen L, Xu J, Dai Q, Luo X, Shan N, et al. Preeclampsia and Its Complications Exacerbate Development of Postpartum Depression: A Retrospective Cohort Study. BioMed Res Int. April 22, 2021; 2021:6641510.

(24) Ruilova JDC, Ponton MPP, Armijos RBO, Ventura MMP. Factores de riesgo de preeclampsia. RECIAMUC. April 1, 2019; 3 (2): 1012-32.

- (25) Allan Vélez C, Cedeño Zambrano R. Estado nutricional de gestantes con diagnóstico de preeclampsia [Internet] [Thesis]. University of Guayaquil. Faculty of Medical Sciences. Medical Technology Career; 2018 [cited Mar 11, 2022]. Available from: <http://repositorio.ug.edu.ec/handle/redug/33976>
- (26) Modelo predictivo de preeclampsia según el consumo de macronutrientes mediante aprendizaje automático en un hospital de Lima, 2019 | Revista Peruana de Investigación Materno Perinatal. July 12, 2021 [cited March 14, 2022]; Available from: <https://investigacionmaternoperinatal.inmp.gob.pe/index.php/rpinmp/article/view/168>
- (27) Sanchez VA, Serrano GG. Perfil de lípidos en pacientes con embarazo de término normotensas y aquellas con preeclampsia.
- (28) Liu C, Liu C, Wang Q, Zhang Z. Supplementation of folic acid in pregnancy and the risk of preeclampsia and gestational hypertension: a meta-analysis. *Arch Gynecol Obstet*. 2018; 298 (4): 697-704.
- (29) Ali AM, Alobaid A, Malhis TN, Khattab AF. Effect of vitamin D3 supplementation in pregnancy on risk of pre-eclampsia - Randomized controlled trial. *Clin Nutr Edinb Scotl*. Apr 2019; 38 (2): 557-63.
- (30) Achamrah N, Ditisheim A. Nutritional approach to preeclampsia prevention. *Curr Opin Clin Nutr Metab Care*. May 2018; 21 (3): 168-73.
- (31) González-Wong C, Fuentes-Barría H, Aguilera-Eguía R, Urbano-Cerda S, Vera-Aguirre V, González-Wong C, et al. El rol de la vitamina D sobre el riesgo de preeclampsia: Revisión narrativa. *Revista chilena de nutrición*. February 2021; 48 (1): 118-25.
- (32) Khaing W, Vallibhakara SAO, Tantrakul V, Vallibhakara O, Rattanasiri S, McEvoy M, et al. Calcium and Vitamin D Supplementation for Prevention of Preeclampsia: A Systematic Review and Network Meta-Analysis. *Nutrients*. October 18, 2017; 9 (10): 1141.
- (33) Zimmermann J, Duarte AM, Silva AC, Batalha S, Silva C, Dias B, et al. Vitamin D and pregnancy. *Pregnancy Hypertens*. October 1, 2018; 13: S51-2.
- (34) Enebe JT, Dim CC, Ugwu EO, Enebe NO, Meka IA, Obioha KC, et al. Serum antioxidant micronutrient levels in pre-eclamptic pregnant women in Enugu, South-East Nigeria: a comparative cross-sectional analytical study. *BMC Pregnancy Childbirth*. July 6, 2020; 20 (1): 392.
- (35) Martínez-González MA, Gea A, Ruiz-Canela M. The Mediterranean Diet and Cardiovascular Health. *Circ Res*. Mar 2019; 124 (5): 779-98.
- (36) Bonneti M A. Aula dieta mediterránea y Vida Saludable. *Actual Med* [Internet]. 103(805). Available from: <https://actualidadmedica.es/wp-content/uploads/805/pdf/am-805-web-.pdf#page=7>
- (37) Martínez-González MÁ, Hershey MS, Zazpe I, Trichopoulos A. Transferability of the Mediterranean Diet to Non-Mediterranean Countries. What Is and What Is Not the Mediterranean Diet. *Nutrients*. November 8, 2017; 9 (11): 1226.
- (38) Cena H, Calder PC. Defining a Healthy Diet: Evidence for the Role of Contemporary Dietary Patterns in Health and Disease. *Nutrients*. Jan 27, 2020; 12 (2): 334.
- (39) Dieta mediterránea: MedlinePlus enciclopedia médica [Internet]. [cited Mar 14, 2022]. Available from: <https://medlineplus.gov/spanish/ency/patientinstructions/000110.htm>
- (40) Sofi F, Dinu M, Pagliai G, Cesari F, Gori AM, Sereni A, et al. Low-Calorie Vegetarian Versus Mediterranean Diets for Reducing Body Weight and Improving Cardiovascular Risk Profile: CARDIVEG Study (Cardiovascular Prevention with Vegetarian Diet). *Circulation*. Mar 13, 2018; 137 (11): 1103-13.

- (41) Di Renzo L, Cioccoloni G, Falco S, Abenavoli L, Moia A, Sinibaldi Salimei P, et al. Influence of FTO rs9939609 and Mediterranean diet on body composition and weight loss: a randomized clinical trial. *J Transl Med.* nov 12, 2018; 16 (1): 308.
- (42) Aecosan - Agencia Española de Consumo, Seguridad Alimentaria y Nutrición [Internet]. [cited Mar 14, 2022]. Available at: [https://www.aesan.gob.es/AECOSAN/web/noticias\\_y\\_actualizaciones/noticias/2017/DI\\_L\\_2017.htm](https://www.aesan.gob.es/AECOSAN/web/noticias_y_actualizaciones/noticias/2017/DI_L_2017.htm)
- (43) Moreno Aznar LA, Cervera Ral P, Ortega Anta RMa, Díaz Martín JJ, Baladia E, Basulto J, et al. Evidencia científica sobre el papel del yogur y otras leches fermentadas en la alimentación saludable de la población española. *Nutr Hosp.* Dec 2013; 28 (6): 2039-89.
- (44) Wade AT, Davis CR, Dyer KA, Hodgson JM, Woodman RJ, Keage HAD, et al. A Mediterranean diet supplemented with dairy foods improves mood and processing speed in an Australian sample: results from the MedDairy randomized controlled trial. *Nutr Neurosci.* Aug 2020; 23 (8): 646-58.
- (45) Jennings A, Tang J, Gillings R, Perfecto A, Dutton J, Speakman J, et al. Changing from a Western to a Mediterranean-style diet does not affect iron or selenium status: results of the New Dietary Strategies Addressing the Specific Needs of the Elderly Population for Healthy Aging in Europe (NU-AGE) 1-year randomized clinical trial in elderly Europeans. *Am J Clin Nutr.* january 1, 2020; 111 (1): 98-109.
- (46) Campos JM, Soto NB. Beneficio del vino en la enfermedad coronaria. *Rev Cienc Salud Integrando Conoc.* february 15, 2021; 5 (1): pp. 13-18.
- (47) Minelli P, Montinari MR. The Mediterranean Diet And Cardioprotection: Historical Overview And Current Research. *J Multidiscip Healthc.* september 27, 2019; 12: 805-15.
- (48) Vitale M, Masulli M, Calabrese I, Rivelles AA, Bonora E, Signorini S, et al. Impact of a Mediterranean Dietary Pattern and Its Components on Cardiovascular Risk Factors, Glucose Control, and Body Weight in People with Type 2 Diabetes: A Real-Life Study. *Nutrients.* aug 10, 2018; 10 (8): 1067.
- (49) Salas-Salvadó J, Díaz-López A, Ruiz-Canela M, Basora J, Fitó M, Corella D, et al. Effect of a Lifestyle Intervention Program With Energy-Restricted Mediterranean Diet and Exercise on Weight Loss and Cardiovascular Risk Factors: One-Year Results of the PREDIMED-Plus Trial. *Diabetes Care.* May 2019; 42 (5): 777-88.
- (50) Tobias Ferrer J, Martin Gallego A, Sant Masoliver C, Simon Pallise C. Impacto sobre la adherencia a la dieta mediterránea desde la consulta de enfermería de atención primaria en pacientes con cardiopatía isquémica. *Aten Primaria.* 2019; 51 (7): 464-6.
- (51) Papadaki A, Martínez-González MÁ, Alonso-Gómez A, Rekondo J, Salas-Salvadó J, Corella D, et al. Mediterranean diet and risk of heart failure: results from the PREDIMED randomized controlled trial. *Eur J Heart Fail.* Sep 2017; 19 (9): 1179-85.
- (52) Sotos-Prieto M, Cash SB, Christophi CA, Folta S, Moffatt S, Muegge C, et al. Rationale and design of feeding America 's bravest: Mediterranean diet-based intervention to change firefighters' eating habits and improve cardiovascular risk profiles. *Contemp Clin Trials.* october 2017; 61: 101-7.
- (53) Enriquez JP, Hernández-Santana A. Dieta mediterránea: modelo de alimentación para contribuir a la salud humana y del planeta. *Rev Fac Cienc Méd Impr.* 2020; 31-7.
- (54) Serra-Majem L. La dieta mediterránea como un ejemplo de Nutrición Adecuada y Sostenible. *Nutr Hosp* [Internet]. june 12, 2018 [cited Mar 14, 2022]; 35 (4). Available from: <http://revista.nutricionhospitalaria.net/index.php/nh/article/view/2133>
- (55) Sáez-Almendros S, Obrador B, Bach-Faig A, Serra-Majem L. Environmental footprints of Mediterranean versus Western dietary patterns: beyond the health benefits of the Mediterranean diet. *Environ Health.* december 30, 2013; 12: 118.

- (56) Perignon M, Sinfort C, El Ati J, Traissac P, Drogué S, Darmon N, et al. How to meet nutritional recommendations and reduce environmental impact in the Mediterranean region? An optimization study to identify more sustainable diets in Tunisia. *Global Food Security*. december 1, 2019; 23: 227-35. Available at: <https://www.sciencedirect.com/science/article/pii/S2211912419300343>
- (57) Apaza J, Gynecologist. *New Approach for the Prevention of Preeclampsia*. december 21, 2017.
- (58) Li M, Grewal J, Hinkle SN, Yisahak SF, Grobman WA, Newman RB, et al. Healthy dietary patterns and common pregnancy complications: a prospective and longitudinal study. *Am J Clin Nutr*. september 1, 2021; 114 (3): 1229-37.
- (59) Syngelaki A, Sequeira Campos M, Roberge S, Andrade W, Nicolaidis KH. Diet and exercise for preeclampsia prevention in overweight and obese pregnant women: systematic review and meta-analysis. *J Matern Fetal Neonatal Med*. oct 18, 2019; 32 (20): 3495-501.
- (60) Assaf Balut C. Reducción de la aparición de diabetes mellitus gestacional por adherencia por adherencia a la dieta mediterránea [Internet]. Complutense University of Madrid; 2017 [cited May 30, 2022]. Available at: <https://eprints.ucm.es/id/eprint/47074/>
- (61) Soltani S, Aminianfar A, Hajianfar H, Azadbakht L, Shahshahan Z, Esmailzadeh A. Association between dietary inflammatory potential and risk of developing gestational diabetes: a prospective cohort study. *Nutr J*. June 2, 2021: 20.
- (62) Parlapani E, Agakidis C, Karagiozoglou-Lampoudi T, Sarafidis K, Agakidou E, Athanasiadis A, et al. The Mediterranean diet adherence by pregnant women delivering prematurely: association with size at birth and complications of prematurity. *J Matern Fetal Neonatal Med*. april 3, 2019;32 (7): 1084-91.
- (63) Minhas A, Hong X, Wang X, Mueller NT. Abstract 051: Pre-pregnancy Cardiometabolic Risk Factors, Mediterranean Style Diet, And Risk of Preeclampsia in The Boston Birth Cohort. *Circulation*. may 25, 2021; 143 (Suppl\_1): A051-A051.
- (64) Kibret KT, Chojenta C, Gresham E, Tegegne TK, Loxton D. Maternal dietary patterns and risk of adverse pregnancy (hypertensive disorders of pregnancy and gestational diabetes mellitus) and birth (preterm birth and low birth weight) outcomes: a systematic review and meta-analysis. *Public Health Nutr*. March 2019; 22 (3): 506-20.
- (65) Tesfa E, Nibret E, Gizaw ST, Zenebe Y, Mekonnen Z, Assefa S, et al. Prevalence and determinants of hypertensive disorders of pregnancy in Ethiopia: A systematic review and meta-analysis. *PLoS ONE*. sep 16, 2020;15 (9): e0239048.
- (66) Nurmiaty, Asi M, Aisa S, Halijah, Yustiari, Usman AN. Eating habits and history of hyperemesis gravidarum as a risk factor of preeclampsia. *Gac Sanit*. january 1, 2021; 35: S501-5.
- (67) Zareei S, Homayounfar R, Naghizadeh MM, Ehrampoush E, Amiri Z, Rahimi M, et al. Dietary Pattern in Patients with Preeclampsia in Fasa, Iran. *Shiraz E-Med J*. September 23, 2019; In Press.
- (68) Assaf-Balut C, García de la Torre N, Fuentes M, Durán A, Bordiú E, del Valle L, et al. A High Adherence to Six Food Targets of the Mediterranean Diet in the Late First Trimester is Associated with a Reduction in the Risk of Maternal-Foetal Outcomes: The St. Carlos Gestational Diabetes Mellitus Prevention Study. *Nutrients*. dec 31, 2018; 11 (1): 66.
- (69) Kinshella MLW, Omar S, Scherbinsky K, Vidler M, Magee LA, von Dadelszen P, et al. Maternal Dietary Patterns and Pregnancy Hypertension in Low- and Middle-Income Countries: A Systematic Review and Meta-analysis. *Adv Nutr Bethesda Md*. december 1, 2021;12 (6): 2387-400.

- (70) Joven Gómez L. The role of the Mediterranean Diet in the prevention and control of Gestational Diabetes. Bibliographic Review. Research project. Available at: [memoria tfg \(unizar.es\)](http://memoria.tfg.unizar.es).
- (71) Hajianfar H, Esmailzadeh A, Feizi A, Shahshahan Z, Azadbakht L. The Association Between Major Dietary Patterns and Pregnancy-related Complications. *Arch Iran Med.* october 1, 2018; 21 (10): 443-51.
- (72) Bakouei F, Delavar MA, Mashayekh-Amiri S, Esmailzadeh S, Taheri Z. Efficacy of n-3 fatty acids supplementation on the prevention of pregnancy induced-hypertension or preeclampsia: A systematic review and meta-analysis. *Taiwan J Obstet Gynecol.* january 1, 2020; 59 (1): 8-15.
- (73) Planinic P, Basu A. Cardiometabolic risks in Pregnant Women. *Int J Environ Res Public Health.* Jan 2020;18 (21): 12045.
- (74) Jaworsky K, Ebersole JL, Planinic P, Basu A. Associations of Diet with Cardiometabolic and Inflammatory Profiles in Pregnant Women at Risk for Metabolic Complications. *Int J Environ Res Public Health.* January 2021; 18 (21): 11105.
- (75) Assaf-Balut C, Torre NG de la, Bordiu E, Valle L del, Valerio J, Jimenez I, et al. Consumption of fat-free dairy products is not associated with a lower risk of maternofetal adverse events. *BMJ Open Diabetes Res Care.* apr 1, 2020; 8 (1): e001145.
- (76) Zhang N, Tan J, Yang H, Khalil RA. Comparative Risks and Predictors of Preeclampsia Pregnancy in the Eastern, Western and Developing World. *Biochem Pharmacol.* December 2020; 182: 114247.
- (77) Achamrah N, Ditisheim A. Nutritional approach to preeclampsia prevention. *Curr Opin Clin Nutr Metab Care.* may 2018;21 (3): 168-73.
- (78) Hofmeyr GJ, Lawrie TA, Atallah AN, Torloni MR. Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. *Cochrane Database Syst Rev.* Oct 1, 2018;10:CD001059.
- (79) Iwama N, Metoki H, Nishigori H, Mizuno S, Takahashi F, Tanaka K, et al. Association between alcohol consumption during pregnancy and hypertensive disorders of pregnancy in Japan: The Japan Environment and Children's Study. *Hypertens Res.* Jan 2019; 42 (1): 85-94.
- (80) Gong W, Zeng N, Corsi D, Wen SW. Association Between Alcohol use in Pregnancy and Preeclampsia or Hypertension in Pregnancy: A Systematic Review [Internet]. In Review; 2020 Jun [cited Mar 22, 2022]. Available at: <https://www.researchsquare.com/article/rs-36772/v1>
- (81) Hounkpatin OI, Amidou SA, Houehanou YC, Lacroix P, Preux PM, Houinato DS, et al. Systematic review of observational studies of the impact of cardiovascular risk factors on preeclampsia in sub-saharan Africa. *BMC Pregnancy Childbirth.* December 2021; 21 (1): 97.
- (82) Traore SS, Bo Y, Amoah AN, Khatun P, Kou G, Hu Y, et al. A meta-analysis of maternal dietary patterns and preeclampsia. *Clin Nutr Open Sci.* december 1, 2021; 40: 15-29.
- (83) Reijnders IF, Mulders AGMGJ, van der Windt M, Steegers EAP, Steegers-Theunissen RPM. The impact of periconceptional maternal lifestyle on clinical features and biomarkers of placental development and function: a systematic review. *Hum Reprod Update.* jan 1, 2019; 25 (1): 72-94.
- (84) Marshall NE, Abrams B, Barbour LA, Catalano P, Christian P, Friedman JE, et al. The importance of nutrition in pregnancy and lactation: lifelong consequences. *Am J Obstet Gynecol* [Internet]. december 27, 2021 [cited March 17, 2022]; Available from: <https://www.sciencedirect.com/science/article/pii/S0002937821027289>

- (85) Durán de la Torre NG, Assaf Balut C, Del Valle L, Ines J, Valerio Deogracia J, et al. 194-LB: Effectiveness of Following Mediterranean Diet (MedDiet) Recommendations in the Real World in the Incidence of Gestational Diabetes Mellitus (GDM) and Adverse Maternal-Fetal Outcomes: A Prospective, Universal Interventional Study. *Diabetes*. June 1, 2019; 68 (Supplement\_1): 194-LB.
- (86) Assaf-Balut C, García de la Torre N, Calle-Pascual AL, Calle-Pascual AL, Torre NG de la, Durán A, et al. Detection, treatment and prevention programs for gestational diabetes mellitus: The St Carlos experience. *Endocrinology, Diabetes and Nutrition*. May 1, 2020; 67 (5): 342-50.
- (87) Tomaino L, Reyes Suárez D, Reyes Domínguez A, García Cruz L, Ramos Díaz M, Serra Majem L, et al. La adherencia a la dieta mediterránea no se asocia al peso al nacer: resultados de una muestra de mujeres canarias embarazadas. *Nutr Hosp*. Feb 2020; 37 (1): 86-92.
- (88) Rogozińska E, Marlin N, Jackson L, Rayanagoudar G, Ruifrok AE, Dodds J, et al. Effects of antenatal diet and physical activity on maternal and fetal outcomes: individual patient data meta-analysis and health economic evaluation. *Health Technol Assess*. Aug 10, 2017; 21 (41): 1-158.
- (89) H. Al Wattar B, Dodds J, Placzek A, Beresford L, Spyreli E, Moore A, et al. Mediterranean-style diet in pregnant women with metabolic risk factors (ESTEEM): A pragmatic multicentre randomised trial. Persson LÅ, editor. *PLOS Med*. July 23, 2019; 16 (7): e1002857.

**Date received:** 20/03/2023

**Revision date:** 10/04/2023

**Date of acceptance:** 27/05/2023