

Obesity in pregnancy



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ABSTRACT

The 2020 edition of the Institute of Health Statistics in Portugal provides information on the health of

pregnant women, childbirth and newborns. In 2022, there were 829,807 births in Portugal, 36% of which involved instrumental delivery by cesarean section. Regarding simple deliveries, 93.2% of the parturients had a pregnancy lasting between 37 and 41 weeks (PORDATA, 2023) and the mean age of pregnant women was 32.2 years. The birth rate in Portugal has been decreasing and maternal age has been increasing, with 97.4% of pregnancies occurring between the ages of 30 and 34 (PORDATA, 2023).

Keywords: Obesity, Pregnant women.

1 INTRODUCTION

1.1 PORTUGUESE PREGNANT WOMEN

The 2020 edition of the Institute of Health Statistics in Portugal provides information on the health of pregnant women, childbirth and newborns. In 2022, there were 829,807 births in Portugal, 36% of which involved instrumental delivery by cesarean section. Regarding simple deliveries, 93.2% of the parturients had a pregnancy lasting between 37 and 41 weeks (PORDATA, 2023) and the mean age of pregnant women was 32.2 years. The birth rate in Portugal has been decreasing and maternal age has been increasing, with 97.4% of pregnancies occurring between the ages of 30 and 34 (PORDATA, 2023).

Regarding infant mortality, it is mainly due to perinatal disorders, which account for 11.9% of infant deaths. Pregnancy complications, maternal comorbidities, other complications of labor and delivery accounted for 31.6% of fetal deaths (PORDATA, 2023).

According to 2019 data, 49.3% of the Portuguese female population over the age of 18 is overweight or obese; however, no information on obesity in pregnancy is available (INE, 2019).

Regarding physical activity (PA), a 2016 study showed that Portuguese pregnant women decrease their PA levels throughout pregnancy and spend most of their time in domestic and occupational activities (P. C. Santos et al., 2016).

Regarding gestational weight gain, a study with Portuguese pregnant women showed that the likelihood of childhood overweight and obesity increases significantly for children born to women



who exceed the recommended weight gain, compared to those who comply with the recommendations for gestational weight gain (Moreira et al., 2007).

2 THE IMPORTANCE OF EPIGENETICS

A child's first 1,000 days, from conception to two years of age, are described by researchers as moments of opportunity (Hennessy et al., 2019).

There is a plausible link between maternal lifestyle and the epigenetic variation of their offspring. The genomic imprinting of genes can play a critical role in terms of fetal development and disease processes (L. Rasmussen et al., 2021), leading to a growing interest in the role of epigenetics in the development of obesity and obesity-related comorbidities (Thaker, 2021).

Epigenetics may be involved in obesity in a number of ways, including through chemical modification that occurs in DNA sequences and can influence gene activity (DNA methylation), modifications in histone protein that also influence genes related to obesity and metabolism, and exposure to adverse conditions during foetal development, that increase the risk of obesity in adulthood (Thaker, 2021).

The current literature clearly demonstrates that the epigenetic response is highly dynamic and influenced by different biological and environmental factors, such as aging, nutrient availability, and FA. Studies show that favorable intrauterine environments, namely the maternal practice of PA, can modulate gene expression through epigenetic alterations, which can result in health benefits and prevent chronic diseases such as metabolic syndrome, diabetes, cancer, obesity, cardiovascular and neurodegenerative diseases (Grazioli et al., 2017).

Therefore, it is important to create and develop programs that promote healthy lifestyles and have a direct impact on the lives of mothers and children, placing researchers and health professionals as the main motivators/advisors for parents to adopt healthy lifestyles, particularly the practice of PA and a balanced diet (Hennessy et al., 2019).

3 OBESITY

Obesity is a serious health problem that has grown exponentially around the world. In 2016, more than 1.9 billion adults aged 18 and over were overweight. Of these, more than 650 million were obese, representing 13% of the world's adult population, with a greater trend towards the prevalence of obesity in women, in all age groups (GBD, 2017). Between 1975 and 2016, the global prevalence of overweight or obese children and adolescents (aged 5 to 19) increased more than fourfold – from 4% to 18% (WHO, 2023c).

The issue of obesity has grown to epidemic proportions, the Global Burden of Disease Group reported in 2017 that "since 1980, the prevalence of obesity has doubled in more than 70 countries and



increased steadily in most other countries" and More than 4 million people die each year as a result of being overweight or obese (GBD, 2017).

Obesity is a pathology characterized by the abnormal or excessive accumulation of fat that poses a risk to health (Piché et al., 2020; WHO, 2023c), is defined by the Body Mass Index (BMI). For an adult individual, a BMI equal to or greater than 25 kg/m² is considered overweight, and equal to or greater than 30 kg/m² is considered obese (WHO, 2023c), Table 1 shows the BMI categories defined by the World Health Organization.

The relationship between obesity and various diseases/comorbidities has been scientifically recognized and clearly explained for a long time. The Global Burden of Disease Group found evidence of a correlation between high BMI and adverse health conditions, including ischemic heart disease, ischemic stroke, hemorrhagic stroke; hypertensive heart disease; diabetes mellitus; chronic kidney disease; cancers of the oesophagus, colon and rectum, liver, gallbladder and bile duct, pancreas, breast, uterus, ovarian, kidney, thyroid, leukemia; osteoarthritis of the knee; Osteoarthritis of the hip and low back pain (GBD, 2017; Piché et al., 2020).

Studies also prove that obesity alters the profile of specific hormones, such as insulin and adipokines, and also alters reproductive function, mainly causing ovulatory disorders that reduce ovulation homeostasis, thus impairing women's fertility (Silvestris et al., 2018).

Table 1- World Health Organization Body Mass Index Categories

| Category | BMI (Kg/m ²) |
|------------------------|--------------------------|
| Low weight | Under 18.5 |
| Normal Weight | 18.5–24.9 |
| Overweight/ Overweight | 25.0–29.9 |
| Class I obesity | 30.0–34.9 |
| Class II obesity | 35.0–39.9 |
| Class III obesity | 40 u superior |

4 OBESITY IN PREGNANCY

Obesity in pregnancy is defined according to pre-gestational BMI. A pregnant woman is considered obese if she has a BMI of 30kg/m² or more (before becoming pregnant) (NICE, 2014; WHO, 2000).

It is estimated that in 2014, about 38.9 million pregnant women worldwide were overweight and obese, of which 14.6 million were obese. The increasing number of pregnant women with obesity in lower-middle-income countries shows a clear influence of economic power on health (Chen et al., 2018).

4.1 COMORBIDITIES ASSOCIATED WITH OBESITY IN THE MOTHER AND OFFSPRING

The risks associated with maternal obesity represent a major public health problem and are well documented. Pregnant women with obesity are more likely to develop gestational complications,



including gestational diabetes, gestational hypertension and preeclampsia, preterm births, postpartum bleeding, anaesthesia problems and consequent thromboembolic infections and complications (ACOG, 2015b; Baeten et al., 2001; Bodnar et al., 2005; Chu et al., 2007; Dodd & Briley, 2017; Doherty et al., 2006; Guelinckx et al., 2008; Marchi et al., 2015; Sebire et al., 2001).

Maternal obesity can also influence labor, it is estimated that there is an increased risk of delivery by caesarean section, failed birth attempt, endometritis, rupture or dehiscence of the cesarean suture, and venous thrombosis (ACOG, 2015b). Increased cholesterol deposits in the myometrium that affect contractions, the volume of maternal soft tissues within the pelvis that narrows the birth canal and makes delivery difficult, especially with macrosomal babies, or the weaker response to oxytocin administration, are the possible factors influencing the higher rate of caesarean sections and instrumental vaginal deliveries in women with obesity.

There is an increased risk of recurrent miscarriage in women with obesity compared to women with normal weight (Boots & Stephenson, 2011; Poston et al., 2015). Pregnant women with obesity are also at increased risk of pregnancies affected by neural tube defects, hydrocephalus, cardiovascular, orofacial, and limb dislocation abnormalities (Stothard et al., 2009).

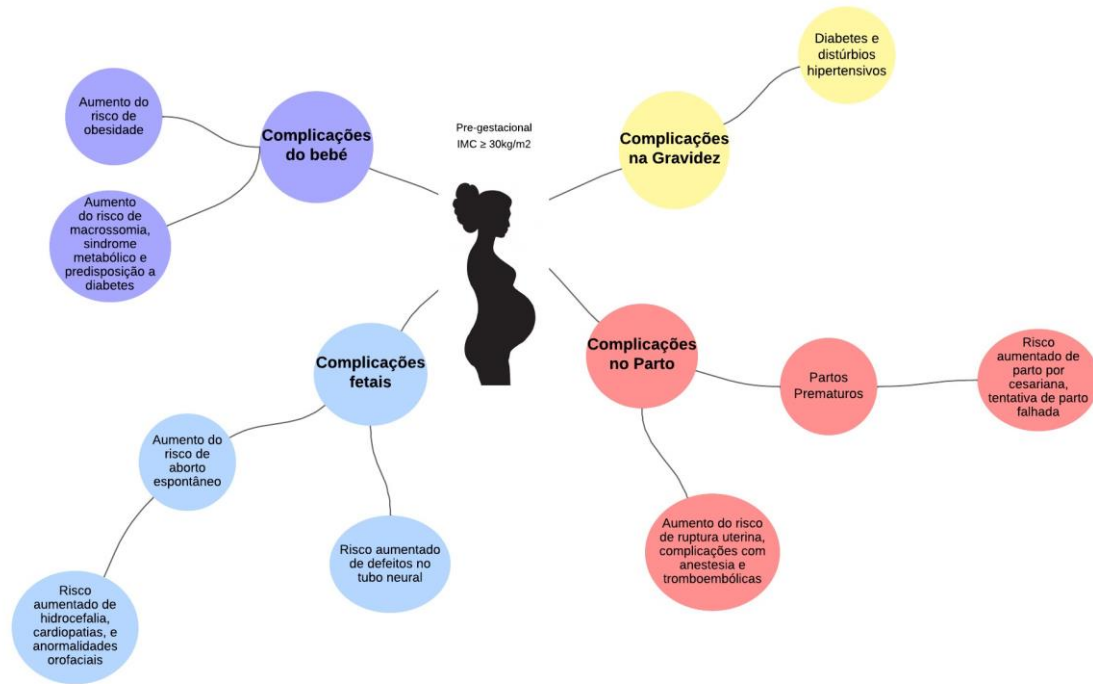
In relation to children born to mothers with obesity or mothers who are overweight during pregnancy, they are also at higher risk of obesity (Blackwell, Landon, Lisa Mele, et al., 2016; Gilmore et al., 2015) macrosomia, metabolic syndrome, and predisposition to diabetes (Catalano & Ehrenberg, 2006).

In addition to the negative repercussions that obesity has on the health of pregnant women and their babies, there is evidence of a close relationship between maternal obesity and low levels of quality of life throughout pregnancy (Amador et al., 2008).

Figure 1 represents the most common pregnancy, maternal, childbirth, and fetal complications in pregnant women with obesity.



Figure 1- Obesity in pregnancy is a risk factor for adverse outcomes



4.2 GESTATIONAL WEIGHT GAIN

Normal and physiological weight gain during pregnancy occurs due to uterine cell division and uterine hypertrophy itself, ductal growth and alveolar hypertrophy in the breasts, increased blood volume and extracellular fluid, and growth of the fetus, amniotic fluid, and placenta. Increased accumulation of water, fat, and cellular proteins, referred to as maternal reserves, may contribute to approximately 3.2kg of full-term maternal weight gain, from (McDowell et al., 2019).

In 2009, the Institute of Medicine (IOM) published guidelines for gestational weight gain (GPG) according to the pre-gestational BMI of the pregnant woman (Table 2). The GPG recommendation for women with obesity is lower, compared to women of normative weight, due to greater fat deposition and therefore significantly lower energy requirements (McDowell et al., 2019). Excessive gestational weight gain is defined as weight gain during pregnancy beyond the limits recommended by the 2009 IOM guidelines (K. M. Rasmussen et al., 2009).

Excessive weight gain in pregnancy and postpartum weight retention compromise future fertility and increase the risk of future pregnancies (Langley-Evans et al., 2022), are associated with an increasing incidence of maternal and neonatal complications, including hypertensive disorders of pregnancy, fetal macrosomia, and increased rates of cesarean delivery (McDowell et al., 2019).



Table 2 - Institute of Medicine Recommendations for Gestational Weight Gain

| Pre-pregnancy weight category | Recommendations for the Weight Gain Range (Kg) | Recommended weight gain in the 2nd and 3rd trimesters (mean range (kg/week)) |
|-------------------------------|------------------------------------------------|------------------------------------------------------------------------------|
| Low weight | 12.5-18 | 0.45 (0.45 – 0.56) |
| Normal | 11.5-16 | 0.45 (0.36 – 0.45) |
| Overweight | 7-11.6 | 0.27 (0.22 – 0.32) |
| Obesity (all categories) | 5-9 | 0.22 (0.18 – 0.27) |

5 PHYSICAL ACTIVITY AND EXERCISE

PA is defined as any voluntary body movement produced by musculoskeletal contraction that results in a substantial increase in caloric requirements in relation to resting energy expenditure (Caspersen et al., 1985; Rhodes et al., 2017). It can be classified as sedentary, mild, moderate and vigorous (Lauer et al., 2017). Sedentary PA includes, for example, reading a book or watching television, light PA consists of activities such as walking leisurely to work, moderate PA encompasses activities such as recreational swimming or moderate-pace cycling, and vigorous PA involves most competitive sports and heavy household chores (Ainsworth et al., 1993).

The Physical Activity Guidelines of the United States of America and the American College of Sports Medicine, both revised in 2018, recommend that for there to be health benefits, healthy adults should perform at least 150 minutes of moderate-intensity exercise per week (the equivalent of 500 METmin/week) and for greater health benefits/gains. recommend practicing in addition to 150 minutes of moderate-intensity exercise per week (ACSM, 2018; USDHHS, 2018).

PA is linked to individual health and there is irrefutable evidence that regular PA reduces the risk of premature mortality and is an effective primary and secondary preventive strategy for at least 25 medical conditions (Rhodes et al., 2017; Warburton & Bredin, 2017).

The concepts of PA and exercise are often used interchangeably, but these terms are not synonymous. Exercise is a type of PA that consists of planned, structured, repetitive body movements made to improve and/or maintain one or more components of physical fitness (Caspersen et al., 1985). Physical fitness has been defined as the ability to perform daily tasks vigorously and alertly, without undue fatigue, and with plenty of energy to enjoy leisure activities and respond to unforeseen emergencies (ACSM, 2018).

5.1 PHYSICAL ACTIVITY IN PREGNANCY

Attitudes towards PA during pregnancy have changed over the past 50 years (Newton & May, 2017). In the past, when women became pregnant, they were promptly advised to reduce or even discontinue the practice of PA due to the risk of complications to the mother and fetus (Briend, 1980), the beliefs were that FA could reduce placental circulation and, as a consequence, increase the risk of disorders such as miscarriages, preterm births, and intrauterine growth retardation (Briend, 1980). This



was mainly due to sociocultural factors and the lack of scientific evidence demonstrating the safety of this practice.

Today, the literature confirms that regular FA during pregnancy is not only safe for the mother and fetus, but also improves important outcomes of pregnancy. PA is closely associated with reduced risk of obesity and excessive gestational weight gain (Ruchat et al., 2018), hypertension, diabetes (ACOG, 2015a; Artal, 2016; Davenport, Ruchat, et al., 2018; Hayes et al., 2015; Lauer et al., 2017), cardiovascular diseases (C. L. Harrison et al., 2011; S. L. Nascimento et al., 2012), preeclampsia (ACOG, 2015a), increased emotional well-being, (ACOG, 2015a; Santo et al., 2017), reduced risk of postpartum depression (ACOG, 2015a; Daley et al., 2015; Hayes et al., 2015; Lauer et al., 2017; Mourady et al., 2017), the risk of caesarean delivery (ACOG, 2020) and can induce beneficial physiological changes in the fetus that will influence its health trajectory (Halfon et al., 2014).

The principles of exercise prescription for pregnant women do not differ from the general population, a thorough clinical evaluation should be carried out before recommending an exercise program with the aim of excluding contraindications to the practice. In the absence of obstetric or medical complications, pregnant women should accumulate at least 150 minutes per week of moderate aerobic exercise or 75 minutes per week of vigorous-intensity aerobic exercise, spread over most days of the week (ACSM, 2018; RANZCOG, 2020). A specific program that leads to a goal of moderate-intensity exercise, for at least 20-30 minutes per day or almost every day of the week should be developed and clinically adjusted with the patient (ACOG, 2020; ACSM, 2018; USDHHS, 2018). Inactive pregnant women should be encouraged to start low-intensity exercise and gradually increase the period or intensity of exercise according to their tolerance (ACOG, 2020).

Studies show that pregnant women spend at least half of their time in sedentary activities, which is similar to the time spent by other population groups, such as children, young people, adults, and the elderly. It is estimated that the impact of sedentary behavior in pregnancy harms maternal and fetal health, but more studies are needed (Fazzi et al., 2017).

Pregnant women believe that PA in pregnancy is important and beneficial, however many barriers to prenatal PA have been identified, such as fatigue, nausea, physical discomfort, lack of time and social support, as well as the influence of low socioeconomic status (A. L. Harrison et al., 2018; P. C. Santos et al., 2016). In addition, fear that FA may compromise fetal safety and pregnancy progress is frequently reported by pregnant women and has been suggested to predict low involvement in prenatal FA (A. L. Harrison et al., 2018; P. C. Santos et al., 2016).

Exercise professionals, such as physical therapists, can make a valuable contribution to important lifestyle modifications by developing safe PA programs tailored to women's personal needs, stage of pregnancy, coexisting musculoskeletal limitations, PA preferences, and sociocultural needs. It is imperative that the best behavior change techniques and person-centered strategies are selected,



capable of responding to intrapersonal and social factors, and that are able to translate the positive attitude of the pregnant woman into greater participation in PA (A. L. Harrison et al., 2018).

5.2 PHYSIOLOGICAL CHANGES RELATED TO PREGNANCY

Chapter II entitled "State of the art" describes the most common physiological changes in pregnancy that have direct implications for physical exercise, namely cardiac, respiratory and hematological changes. In this introductory note, we will address the most evident musculoskeletal changes during pregnancy.

5.3 PREGNANCY-RELATED MUSCULOSKELETAL DISORDERS

The physiological adaptations of pregnancy lead to unique musculoskeletal changes. The gravid uterus displaces organs and the center of gravity anteriorly, causing biomechanical modifications such as increased lumbar lordosis. The increase in lumbar curvature in pregnancy is caused by the induction of forces from the uterus and accentuation of the anterior pelvic tilt. The sacroiliac joints resist this forward rotation. As pregnancy progresses, both forward rotation and hyperlordosis increase as the sacroiliac ligaments become looser. These factors contribute to increased mechanical strain on the lower back, sacroiliac, and pelvis (Borg-Stein & Dugan, 2007; Cain et al., 2021).

Low back pain is a common condition during pregnancy and encompasses three distinct sources of pain: axial lumbosacral, radicular and referred pain (Urits et al., 2019). Research shows that low back pain is a very common pathology and often affects women during pregnancy and has a major impact on their daily lives (Hu et al., 2020; Koukoulithras et al., 2021). Regarding the prevalence, studies show that low back pain can reach between 50% and 90% of pregnant women and that in 25% of women, the pain is perpetuated one year after childbirth (Biviá-Roig et al., 2019; Davenport, McCurdy, et al., 2018; Koukoulithras et al., 2021; Liddle & Pennick, 2015; Shiri et al., 2017; Wiezer et al., 2020).

It is estimated that in pregnant women, low back pain is four times more common than in non-pregnant women (Kashanian, 2009). This condition can occur during the first trimester of pregnancy, but for most women, it begins around the eighteenth week of gestation, with peak intensity occurring between the twenty-fourth and thirty-sixth weeks of gestation (Sencan et al., 2018; Vermani et al., 2010; Wu et al., 2004). Gestational low back pain has considerable implications for women and society, namely low quality of life, low productivity and consequent public health costs (Garshasbi & Faghieh Zadeh, 2005; Hu et al., 2020; Mohseni-Bandpei et al., 2009; Oliveira et al., 2018).

The hormonal changes of pregnancy cause systemic effects on the musculoskeletal system, including increased laxity of the peripheral and pelvic joints and decreased bone mineralization. These



changes may predispose patients to certain musculoskeletal injuries, such as ligament injuries and insufficiency fractures (Cain et al., 2021).

Soft tissue edema during pregnancy is reported by approximately 80% of women. Increased fluid retention may predispose to tenosynovial or nerve entrapment (Borg-Stein et al., 2005; Borg-Stein & Dugan, 2007).

6 PREGNANCY AS AN OPPORTUNITY FOR CHANGE

There are particular events or a set of circumstances that lead individuals to change their health in a positive way. Authors consider this set of circumstances to be "teachable moments" (Lawson & Flocke, 2009). These moments are extremely important for researchers whose goal is to promote healthy behaviors and well-being.

Teachable moments are characterized as moments that increase personal risk perception and outcome expectations. They provoke strong affective or emotional responses and redefine self-concept or social roles (McBride et al., 2003).

Pregnancy, for most women, is a time of worry, emotional responses and redefinition of oneself as a woman, it can effectively be considered a "teachable moment" in the adoption of healthy behaviors such as eating and PA practice (Phelan, 2010).

Considering that pregnant women are in constant contact with health professionals, clinic-patient interaction can be central to the creation of teachable moments with the aim of promoting health behavior change (Lawson & Flocke, 2009), in 2010 Phelan concluded that "intervening during pregnancy can capitalize on this natural period of reset that occurs among women," making it an ideal time to encourage women to be healthy (Phelan, 2010).

Also women's empowerment, defined as "the process by which those who have been denied the ability to make strategic life choices acquire such an ability" (Kabeer, 1999) It is a driver for better maternal and child health outcomes, especially in developing countries (Pratley, 2016; WHO, 2023a). Women's power to make decisions about their health is an important part of empowerment. Having decision-making power and believing in your own self-efficacy to take control over the decisions you face in the perinatal period is a facilitator for behavior change that can positively influence your health and that of the unborn child (Nieuwenhuijze & Leahy-Warren, 2019).

The World Health Organization's Global Strategy to Improve Maternal and Newborn Health, Survival and Stillbirth Reduction (WHO, 2023a), is committed to facilitating women's empowerment and positive birth outcomes, both physically and psychologically, for women, infants, and families. It also aims for all women to make informed decisions about their sexual or maternal health, placing the individual as the greatest promoter and responsible for their own health (WHO, 2023a).



The role of new technologies and the Internet in disseminating health information is increasing (Senbekov et al., 2020). Individuals have easy access to platforms, websites, and gadgets that facilitate lifestyle changes while also being inexpensive for users (Matheve et al., 2017). Thus becoming important vehicles for the dissemination of information and empowerment.

7 E-HEALTH

The e-Health is a network of technological applications that, with the help of the Internet, provides health services, with the aim of improving the quality of life and streamlining the provision of health care (da Fonseca et al., 2021). The COVID-19 pandemic has rapidly transformed healthcare systems and the way healthcare is delivered to users, with the e-Health One of the main drivers of change (Greiwe & Nyenhuis, 2020). This type of intervention has the advantage of being similar to face-to-face care, promoting active patient engagement and producing more positive clinical outcomes (Barello et al., 2016; Shigekawa et al., 2018). It has been shown that the health of e-Health Eliminates geographical barriers and has the potential to reach more people, at lower costs (Joseph et al., 2014; Matheve et al., 2017) e It also offers a pathway to overcome emotional and social challenges (Banbury et al., 2018; Shigekawa et al., 2018). The use of health e-Health Through lifestyle interventions, it has been shown to be effective in improving clinical and health outcomes among individuals with cardiometabolic diseases (T. Cohen et al., 2023), including obesity (Lau et al., 2020).

The use of monitored home programs is becoming increasingly common and is used in a large number of pathologies (Block et al., 2016; Brouwers et al., 2020; Correia et al., 2018, 2019; Gandolfi et al., 2017; Matheve et al., 2017; Vieira et al., 2017). Specifically in pregnant women, it has been used as a tool to change sedentary behavior (Sandborg et al., 2021), to promote healthy eating (Carolan-Olah et al., 2021), to control gestational diabetes (C. Kim et al., 2012; Nicklas et al., 2014), promote recommended gestational weight gain (Graham et al., 2014) and to improve mental health (Carissoli et al., 2019; Krusche et al., 2018; Zuccolo et al., 2021).



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