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Article

Macrosomia, gestational diabetes, maternal-child health and SDGs: A review

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Abstract: Neonatal macrosomia is defined by a birth weight of ≥4000 g at term and is accompanied by frequent and concerning complications of gestational diabetes. This condition is associated with a high risk of obstetric, neonatal, and long-term complications. In the Moroccan context, the management of gestational diabetes remains unevenly applied, with notable disparities in patient education and the involvement of healthcare professionals. Macrosomia acts as a marker for intrauterine overnutrition and metabolic dysregulation, creating a high-cost trajectory for both neonatal and maternal health systems. The main objective of this study is to treat the macrosomia and health sustainability, social policy and preventative solutions, alignment with sustainable development goals (SDGs), policy-oriented recommendations and the risk of macrosomia to the sustainable development goals for maternal and child health in Morocco.

Keywords: Macrosomia; gestational diabetes; risk factors; neonatal complications; prevention

1. Introduction

Maternal and neonatal outcomes are adversely affected by macrosomia, which is defined as a birth weight greater than 4000 g [1–3]. The frequency of fetal macrosomia differed by area [4–13] due to a number of contributing factors examined in several studies [6–15]. Three to fifteen percent of pregnancies worldwide are affected by macrosomia [16]. Between 5 and 20% of all births in the developed world have macrosomia [17]. Both mothers and newborns experience difficulties during delivery due to fetal macrosomia [18]. Birth asphyxia, stillbirth, obesity, and metabolic abnormalities are among the short- and long-term health problems that macrosomica babies are more likely to experience [19–21]. An increased risk of several malignancies is also linked to infant macrosomia [22–25]. Furthermore, fetal macrosomia has been linked to shoulder dystocia, bone injuries, meconium aspiration, hypoglycemia, and fetal death [26]. Similarly, type 2 diabetes mellitus, hypertension, and adult obesity are long-term health consequences of macrosomia [27]. Furthermore, the main maternal problems caused by fetal macrosomia include postpartum hemorrhage, perineal tears, protracted labor, shoulder dystocia, uterine rupture, and maternal fatalities [21]. Other maternal consequences of macrosomia include oxytocin-assisted labor augmentation, cesarean delivery, infection, unsuccessful instrumental births, wound complications, thromboembolic events, and anesthetic mishaps [28–30]. Addressing this condition requires shifting from a purely clinical reactive approach to a proactive, preventive strategy that integrates social determinants of health and long-term health system resilience. Compared with developed countries, research on macrosomia in developing world such as Ethiopia, particularly in the study

settings are insufficient. Also, adverse maternal and neonatal outcomes due to macrosomia can lead to additional maternal and neonatal risks in a resource-limited country because of the restricted availability of basic emergency obstetric and newborn care [30]. Understanding certain modifiable risk factors for macrosomia such as high pre-pregnancy body mass index, high blood glucose level during pregnancy and low level of pre-gestational physical activity is crucial for health care providers to prevent macrosomia by suitable diet and insulin therapy [31]. Hence, this study aimed to determine the magnitude of fetal macrosomia and associated factors at public health institutions of Hawassa city, southern Ethiopia. Macrosomia (defined as birth weighs 4000 g or >90th percentile) is a significant reproductive health challenge with substantial long-term implications for health system sustainability, social policy, and the UN Sustainable Development Goals (SDGs). The goal is to build a conceptual framework showing how preventing macrosomia ensures resilient healthcare systems and drives the Sustainable Development Goals (SDGs), specifically by optimizing maternal health and reducing systemic economic burdens. Core Objectives are:

- Clinical Prevention: This core delivery, designed to reduce the incidence of macrosomia by addressing maternal obesity, gestational diabetes, and poor nutritional environments during pregnancy.
- Resource Optimization: Conserve strained healthcare resources (e.g., lower rates of emergency C-sections and NICU admissions).
- Syndemic Integration: Connect maternal metabolic health with systemic, long-term global sustainability targets [31].

2. Methodology

A priori protocol was developed for this overview but was not registered with the International Prospective Register of Systematic Reviews (PROSPERO), as the review was primarily methodological in nature and did not meet PROSPERO eligibility criteria for registration. The protocol is available from the corresponding author upon reasonable request. This overview was conducted based on the guidelines for the conduct of overviews as outlined in The Cochrane Handbook [32]. Reporting followed the Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA) statement [33].

2.1. Eligibility criteria

All published reviews, whether or not they included a methodological analysis, were included in this review. The key characteristics of the reviews were determined on the basis of the Cochrane Handbook [34]. According to the Handbook, the following criteria must be met for a review to be considered methodologically sound:

(a) clearly states the objectives and eligibility criteria for study inclusion;
(b) provides reproducible methodology;
(c) includes a systematic search to identify all eligible studies;
(d) reports assessment of validity of findings of included studies (e.g., RoB assessment of the included studies);
(e) systematically presents all the characteristics or findings of the included studies [34].

Reviews that did not meet all of the above criteria were not considered a SR for this study and were excluded. MA-only articles were included if it was mentioned that the MA was based on an SR. SRs and / or MA of primary studies evaluating methodological approaches used in defining review scope and study eligibility, literature search, study selection, data extraction, RoB assessment, data synthesis, and CoE assessment and reporting were included. The methodological approaches examined in these SRs and / or MA can also be related to the sub-steps or elements of these steps [34].

2.2. Search

The search for published SRs was performed on the following scientific databases initially from inception to third week of November 2020 and updated in the last week of February 2022: MEDLINE (via Ovid), Embase (via Ovid), Web of Science Core Collection, Cochrane Database of Systematic Reviews, and American Psychological Association (APA) PsycINFO. Search was restricted to English language publications. Following the objectives of this study, study design filters within databases were used to restrict the search to SRs and MA, where available. The reference lists of included SRs were also searched for potentially relevant publications.

The search terms included keywords, truncations, and subject headings for the key concepts in the review question: SRs and / or MA, methods, and evaluation. Some of the terms were adopted from the search strategy used in a previous review by Robson et al, which reviewed primary studies on methodological approaches used in study selection, data extraction, and quality appraisal steps of SR process [35]. Individual search strategies were developed for respective databases by combining the search terms using appropriate proximity and Boolean operators, along with the related subject headings in order to identify SRs and / or MA [36].

2.3. Study selection and data extraction

The aim of this research is to identify and compare data from published articles on systematic reviews (SRs) in order to evaluate the various methodological approaches used at each stage of an SRThis study utilised five electronic databases, covering the period from their inception up to November 2020, and was subsequently updated in February 2022: MEDLINE, Embase, Web of Science

Core Collection, the Cochrane Database of Systematic Reviews and APA PsycINFO. The screening of titles and abstracts was carried out in two stages by one reviewer, assisted by a second reviewer. A The screening of full-text articles, data extraction and quality assessment were carried out independently by two reviewers. The quality of the selected systematic reviews was assessed using the AMSTAR 2 checklist.

The literature search yielded 41,556 unique references, of which 9 systematic reviews (SRs) were deemed eligible for inclusion in the final synthesis. These SRs evaluated 24 unique methodological approaches for defining the scope and eligibility criteria of the study, the literature review, data collection and the quality of the evaluation within the SR process. Limited evidence supports the following practices: searching multiple sources (electronic databases, manual searches and reference lists)

to identify relevant literature; excluding non-English-language literature, 'grey' literature and unpublished literature; and using text-mining techniques when selecting titles and abstracts [36,37].

3. Macrosomia and health sustainability

Macrosomia acts as a marker for intrauterine overnutrition and metabolic dysregulation, creating a high-cost trajectory for both neonatal and maternal health systems. A new study published in the Journal Reproductive and Developmental Medicine (RDM) has found a strong association between fetal macrosomia (high birth weight) and overweight and obesity in early childhood among the U.S.-born children aged 2–6 years. The researchers suggested fetal macrosomia may be a marker of intrauterine overnutrition and metabolic dysregulation, which may predispose children to excess weight gain and obesity later in life. They recommended that prenatal care providers should monitor fetal growth and counsel pregnant women about the potential risks and complications of having a large baby, as well as the importance of healthy lifestyle behaviors for themselves and their children. This study is one of the first to examine the link between fetal macrosomia and childhood obesity in a nationally representative sample of the U.S.-born children. The findings may have important implications for the prevention and management of obesity and its related chronic diseases in the U.S. population. Preventing in-utero over-nutrition and weight gain during pregnancy could be a promising strategy to break the vicious transgenerational cycle of obesity crisis and mitigate the risks towards the subsequent generations, particularly among the populations of color [38].

* Long-Term Health System Resilience: Babies with Macrosomia are 1.5 times more likely to grow up to be overweight or obese. This puts long-term strain on health resources by increasing the future prevalence of metabolic illnesses, diabetes, and cardiovascular diseases.

* Resource Management and Preventative Focus: Preconception weight control and glycemic control are two examples of effective prevention that can significantly reduce the need for specialized care (NICU stays, emergency cesarean sections), which lowers the immediate and long-term financial burden.

* Environmental Factors and Green Space: Research indicates that increased exposure to green space during pregnancy, particularly in the ninth month, is associated with a decreased risk of macrosomia. This suggests that environmental health policies and urban planning are sustainable, indirect means of improving birth outcomes [39].

4. Social policy and preventative solutions

Other socioeconomic factors affect students' HRQoL in addition to multimorbidity and health-related concerns [40].

4.1. Targeting obesity and metabolic health

With obesity rising globally, public health interventions aimed at reducing pre-pregnancy high BMI are critical, as high BMI is a major factor in the growing global burden of macrosomia [40].

4.2. Preconception and prenatal education

Social policies should prioritize education and support for healthy lifestyles, including nutrition counseling and promotion of physical activity, which can reduce macrosomia risk [40].

4.3. Standardized screening protocols

Strengthening prenatal care to include early, consistent screening for Gestational Diabetes Mellitus (GDM) is a key policy tool [40].

5. Alignment with sustainable development goals (SDGs)

In order to ensure lasting effect, reduce poverty, and mitigate climate change, organizations must map their strategies, programs, or policies to the 17 sustainable Development Goals (SDGs) of the United Nations (2030 Agenda). Setting quantifiable goals, reporting progress, forming alliances, and determining pertinent objectives are all necessary steps in this process. Key Components of SDG Alignment are:

- Strategic integration: Connecting company activities or development projects to the 17 goals, ensuring that initiatives do not compromise any goals while advancing others.
- Targeting and measurement: Using the 169 specific targets and related indicators to define success and measure progress, often integrating them into ESG reporting.
- Partnerships (Goal 17): Fostering multi-stakeholder partnerships and public-private collaborations to share knowledge and resources to maximize impact.
- Sector-specific action: Examples include increasing renewable energy (Goal 7), protecting ecosystems (Goal 15), and enhancing agricultural productivity (Goal 2) [40].

Using the Sustainable Development Goals (SDGs) of the UN as a framework, APRIL has collaborated with PwC Singapore since 2017 to evaluate the effects of its business operations. According to the study, 41 SDG targets across 15 goals are directly impacted by the results and outputs of APRIL's commercial operations. Seven priority SDGs were first identified after PwC conducted a thorough analysis of the data that was already available, focusing on APRIL's business operations, peer benchmarking, and national and provincial data and literature. These included four catalytic goals where the company feels it can also have a positive impact and three core goals that are directly aligned with APRIL's operations. The project's basic methodology was documented in an early report on this phase of the project that was released in 2025. In addition to giving APRIL a worldwide framework for coordinating its sustainability pledges and plans with the global development agenda, the SDGs also assist the company in strategically allocating its resources and initiatives to areas of most need. From a practical and operational standpoint, this also facilitates APRIL's capacity to link its sustainability plans and contributions to national and international goals and convert them into actions that promote Indonesia's attainment of the SDGs at all societal levels. APRIL has a set of goals to meet by 2030 thanks to the APRIL2030 commitments. To guarantee that progress can be routinely

assessed and that they are closely associated with the UN SDGs, all of the commitments have been created with targets and indicators [40].

Addressing macrosomia directly contributes to several UN SDGs, specifically:

5.1. SDG 3 (Good health and well-being)

Preventing macrosomia reduces maternal mortality and morbidity (including obstetric injury and cesarean rates) and improves long-term health outcomes for children.

5.2. SDG 2 (zero hunger - nutrition)

Better pre-pregnancy nutritional support and gestational nutrition improve metabolic health for both mother and child.

5.3. SDG 10 (reduced inequalities)

Targeted interventions for high-risk populations can improve reproductive health equity [40].

5.4. Conceptual framework linking macrosomia to SDGs

The framework operates on three interconnected tiers, translating clinical health outcomes into macro-level sustainable development:

- Drivers of macrosomia (social determinants)

Goal 2: Zero Hunger - Focuses on ending all forms of malnutrition. This involves tackling overnutrition and the consumption of high-calorie, low-nutrient diets that fuel maternal obesity.

Goal 10: Reduced inequalities - Addresses the socioeconomic disparities that restrict access to healthy foods and quality prenatal care, leading to higher rates of gestational diabetes.

- Clinical impact & healthcare sustainability

Macrosomia causes elevated risks of shoulder dystocia, birth trauma, and the need for operative deliveries, which severely strain healthcare infrastructure and budgets. Addressing this relies heavily on:

Goal 3: Good health and well-being - Target 3.1 (reducing maternal mortality) and Target 3.4 (reducing premature mortality from non-communicable diseases, like diabetes). Preventing macrosomia directly protects both mother and infant from short- and long-term metabolic complications.

Healthcare resource allocation - Sustainable health systems require a shift from costly acute interventions (e.g., C-sections, neonatal intensive care) to preventive, community-based antenatal care and lifestyle management.

- Long-term socioeconomic repercussions (SDG interlinkages)

Goal 1: No poverty - The out-of-pocket costs of treating complicated deliveries and managing childhood or maternal chronic diseases plunge families into poverty.

Goal 3 / Goal 8: Decent work and economic growth - Maternal health and early childhood development are foundational to economic productivity. Healthier pregnancies lead to stronger workforce participation and reduce the economic drag of chronic non-communicable diseases [40].

6. Policy-oriented recommendations

A strategy that guarantees that health systems are reinforced with extensive social support mechanisms is necessary to promote the Sustainable Development Goal 3 (SDG 3) of Good Health and Well-Being of All People. The importance of this relationship in achieving equitable and sustainable healthcare is becoming more widely acknowledged. Focused welfare and security initiatives are crucial in solidifying SDG 3 since social vulnerabilities and economic instability directly affect health outcomes and access. This work integrates interdisciplinary research to bridge the gap between economic security and health policy at a time when social policy decisions should, more than ever, be informed by evidence and real-world needs. It addresses important factors, interventions, and policymakers' contributions to strategies that can strengthen health systems. Thus, SDG 3's existing accomplishments are examined, as are the difficulties in effectively integrating the social support and health sectors. As part of this next wave of developing health systems resilience, the report discusses future approaches to accomplish this goal, such as increased public investment in inter-sectoral collaboration, creative funding structures, and data-driven policymaking. Strengthening social safety nets and reducing the negative health effects of poverty and unfavorable economic circumstances are crucial strategies for restructuring public health with less inequality. Policymakers are assured of their efficacy in accomplishing these policy targets through evidence-based monitoring systems, cross-sectoral cooperation, and coordinated governance. For resilient health systems backed by inclusive welfare state policies, this necessitates priority planning that makes investments in scalability, sustainability, and adaptation [40].

- **Integration of care:** Establish multisectoral collaborations involving nutritionists, obstetricians, and urban planners to tackle the root causes of macrosomia.
- **Data-driven policy:** Improve data systems to track birth weights and monitor the impact of public health interventions in real time.
- **Postpartum follow-up policies:** Implement mandatory postpartum surveillance and lifestyle counseling for women who have delivered a macrosomia child, as they face a higher risk of future metabolic disorders [40].

7. Four core principles for sustainable healthcare delivery

Sustainable healthcare meets the need of the present population without endangering the health or capacity to provide for the needs of future generations. All of us depend on a stable environment with uncontaminated air and dependable food and water supplies. This is becoming more and more threatened by the global climate and ecological problem. Healthcare systems must stop damaging the environment and stay within environmental bounds in order to be really sustainable, in addition to considering the financial and social effects. The Centre for Sustainable Healthcare (CSH) has developed a set of principles that can guide healthcare practitioners in creating and embedding low carbon practices wherever they are:

- Prevention: Preventing any illness is the best method to enhance patient care while lowering emissions. In the health service, primary care is crucial to

disease prevention. At Greener Practice, we think primary care should be prioritized and funded in a way that more successfully promotes health promotion and disease prevention. Additionally, primary care can be crucial in collaborating with nearby populations "upstream." For instance, by encouraging healthy, sustainable eating, active transport, the utilization of natural spaces, and the reduction of air pollution.

- Empowerment of patients: Making patient-centered decisions is a key component of a Greener Practice approach to quality healthcare. This promotes health awareness and empowerment as well as improved treatment adherence. Therefore, there is a lot of overlap between goals like person-centered care, collaborative decision making, and realistic medicine and a "green" approach.
- Lean Routes: Lean systems include things like clear and proper diagnosis, thorough evaluation of relevant investigations and treatment, streamlined methods to prevent duplication of care, fewer hospital visits, and avoidance of wasteful activities.
- Low-Carbon Substitutes: By selecting low-carbon alternatives, we may lower the carbon footprint of healthcare without harming (and frequently even benefiting) patients. Reusable PPE, reusable surgical tools, and less impactful prescription choices are a few examples of this. After some consideration, these can also present us with a chance to enhance care. Take a look at our "asthma toolkit" section, which examines the coexistence of high-quality respiratory care and low carbon emissions.

The four fundamental principles of sustainable healthcare delivery aim to reduce the environmental footprint of the medical sector while maintaining or improving the quality of care provided to patients. This core delivery, designed to improve patient outcomes while reducing environmental impact and costs [41].

7.1. Evidence-based decisions

Using data-driven, evidence-based practices to manage resources efficiently and improve patient outcomes [41].

7.2. Social responsibility

Healthcare providers must act as advocates, promoting sustainable behaviors and environmental awareness within their communities [41].

7.3. Waste reduction and reusability

Switching to reusable, clinically safe materials to lower the environmental footprint of hospitals.

By moving away from only clinical efficiency and toward a more comprehensive strategy that takes into account the effects on the environment, society, and economy, these concepts seek to redefine "value" in healthcare. Putting these into practice, especially in clinical guidelines, contributes to the development of a more robust and long-lasting health system [41].

8. "Risk of macrosomia" to the sustainable development goals for maternal and child health in Morocco

Morocco has made significant progress in the fight against maternal and infant mortality. The maternal mortality rate has decreased by 78% and the mortality rate for children under five by 71%. Morocco is thus on track to achieve the Sustainable Development Goals (SDGs) in this area. This was indicated by the Minister of Health and Social Protection, Khalid Ait Taleb, during a thematic session focused on "the generalization of quality health services and social protection," organized as part of the 7th edition of the International Parliamentary Forum on Social Justice.

A report recently prepared by several organizations, namely UNICEF, WHO, the World Bank, and the Population Division of the United Nations Department of Economic and Social Affairs, revealed that the infant mortality rate decreased from 64 deaths per 1000 in 1990 to 15 deaths per 1000 in 2021. The number of infants who died was 10,000 in 2021 compared to 45,000 in 1990. Meanwhile, the mortality rate of children under 5 in Morocco decreased from 81 deaths per 1000 births in 1990 to 18 deaths per 1000 births in 2021, representing an annual reduction of 4.8%.

The number of deaths of children under 5 years old decreased from 58,000 in 1990 to 34,000 in 2000 and then to 12,000 deaths in 2021. During this session, the minister announced that the birth rate in healthcare facilities has increased by 55%, which is a positive indicator, alongside the rate of children vaccinated against childhood diseases. Life expectancy at birth has increased by 30 years over the past 50 years. As for the fertility rate, it has decreased from 7 in the 1960s to 2.4 currently. The minister of health emphasized the importance of an equal and fair distribution and better governance of healthcare services.

"The COVID-19 pandemic has given countries the opportunity to establish more adapted and resilient social protection systems and to adopt a forward-looking approach in risk management," she indicated.

The Ministry of Solidarity adopted a participatory and inclusive approach by launching extensive national consultations in all regions of the Kingdom in December 2021. These consultations enabled the ministry to develop a new strategy, which is based on a new vision of social sector interventions and focuses on strengthening social bonds, ensuring dignity, achieving equality, and enhancing the resilience of families and individuals. This new strategy lays the foundations for a new social architecture, through the launch, for the first time, of the unified digital social counter "GISSR" based on proximity, digitization, sustainability, and the establishment of social incubators for the integration of vulnerable groups [42,43].

8.1. Alignment with the sustainable development goals (SDGs) in Morocco

The control of macrosomia is directly linked to Morocco's priority targets for 2030:

- SDG 3.1 (Maternal mortality): Macrosomia increases the incidence of postpartum hemorrhage (1.9% of cases in Morocco) and uterine ruptures. These complications are direct causes of maternal deaths that Morocco is committed to reducing to less than 70 per 100,000 live births.

- SDG 3.2 (Neonatal Mortality): It exposes the newborn to shoulder dystocia, perinatal asphyxia, and trauma (brachial plexus paralysis in 2.1% of cases), compromising the goal of eliminating preventable newborn deaths [43].

8.2. Analysis of socio-economic factors and disparities

The incidence of macrosomia in Morocco, estimated between 7.5% and 10.9% according to regional studies, is influenced by structural determinants:

- Urban Epidemiological Transition: In urban areas, the evolution of lifestyles promotes maternal obesity and gestational diabetes, two major causes of macrosomia.
- Rural-Urban Disparities:

* Access to Care: In 2018, maternal mortality was 111 per 100,000 in rural areas compared to 45 in urban areas. This gap limits the early detection of gestational diabetes in rural areas.

* Health Education: Limited access to nutritional information in rural areas delays the management of metabolic risk factors.

* Social Coverage: Historically, only 3.8% of rural residents had health coverage (compared to 21.8% in urban areas). The current generalization of the mandatory basic health insurance AMO aims to correct this equity bias [43].

8.3. Prevention strategies and policy recommendations

To promote equity and reduce risks, the following interventions are recommended:

8.3.1. Community and proximity support

- Health mediators: Generalize the Taza model which trains community mediators through the National Initiative for Human Development (INDH) to raise awareness among families about nutritional risks and guide pregnant women.
- Community health system (CHS): Strengthen coordination between Rural Health Centers and Dar Al Oumouma (maternity houses) to ensure quality prenatal care, including monitoring of uterine height [44].

8.3.2. Public policies and prevention

- National nutrition strategy 2024–2030: Integrate parental education programs specifically focused on the prevention of overweight and diabetes from pregnancy.
- Accessibility of screening: Systematize the screening of gestational diabetes in primary care facilities, particularly for multiparous women or those with a history of macrosomia.
- Territorial equity: Deploy mobile units of neonatology and obstetrics in "mountain areas" to manage deliveries at risk of dystocia [45].

8.4. previous studies without sufficient critical discussion

To elevate a descriptive literature review into a strong, analytical synthesis, you must move beyond listing study findings. Focus instead on identifying underlying

patterns, evaluating methodological limitations, and critically discussing how these insights shape the clinical management of fetal macrosomia.

A robust, synthesized analytical framework requires critical discussion across four main pillars:

8.4.1. Critically appraise the methodological limitations

Rather than accepting findings at face value, analyze how studies are designed.

- The diagnostic dilemma: Acknowledge that the literature is heavily hindered by inconsistent macrosomia definitions (varying between birth weights of (4000\ g) or (4500\ g)) and unreliable prenatal weight estimation. Critically discuss how the inability to accurately predict birth weight via ultrasound impacts maternal anxiety and clinical decision-making [46].
- Confounding variables: Note that many observational studies fail to adequately separate the independent impacts of advanced maternal age, male fetal sex, and excessive gestational weight gain from pre-existing or gestational diabetes mellitus (GDM) [47].

8.4.2. Synthesize maternal-child health impacts

Synthesize the disparate health consequences into a cohesive narrative regarding the cascades of intervention and long-term risk.

- Intrapartum risks: Group findings by immediate birth risks, critically synthesizing how macrosomia drives a two to threefold increase in emergency cesarean sections, severe perineal lacerations, and postpartum hemorrhages [48].
- Neonatal trauma: Discuss the intersection of birth weight and delivery methods (e.g., vaginal vs. elective cesarean), noting the heightened risk of shoulder dystocia, clavicular fractures, and brachial plexus injuries [48].

8.4.3. Analyze mechanisms of causation

Explore and compare the varying pathophysiological pathways that contribute to macrosomia.

- Maternal hyperglycemia: Synthesize the clinical consensus that maternal glucose concentration is a linear driver of fetal adiposity and hyperinsulinemia (the Pederson hypothesis), while critically assessing why macrosomia still occurs in mothers with strictly controlled or absent diabetes [48].
- Obesity and gestational weight gain: Discuss the role of pre-pregnancy obesity and excessive weight gain on pro-inflammatory, lipotoxic intrauterine environments. Analyze how modifiable maternal exposures offer targets for intervention [48].

8.5. Policy and clinical implications

A critical review must be concluded by translating scientific literature into actionable maternal health policy [49].

- Preventative measures: Discuss the literature's consensus on the importance of preconception counseling and individualized antenatal care plans that emphasize low-glycemic diets and weight management [49].

- Delivery management: Critically evaluate the ongoing debate surrounding expectant management versus elective induction / cesarean, particularly concerning suspected weights \ (>4500\ text {g}\) in diabetic mothers or \ (>5000\ text{g}\) in non-diabetic mothers [49].

For further reading on the most robust pooled data and clinical management guidelines, consult the comprehensive analysis provided by the StatPearls Fetal Macrosomia Review or the official RANZCOG Clinical Guidance Statement on suspected fetal macrosomia [49].

Fetal macrosomia (birth weight \ (>4000\) g) in Morocco is increasingly recognized as a public health priority. Driven by the nation's rising rates of female obesity and overweight, it significantly complicates deliveries. Key factors include a higher prevalence of male neonates, prolonged gestation, and maternal gestational diabetes [49].

8.5.1. Current statistics & prevalence

- National obesity & overweight: National data shows that (35.7%) of adult Moroccan women are living with obesity. Across the general population, nearly (20%) are obese and (53%) are classified as overweight [49].
- Macrosomia prevalence: The prevalence of macrosomia in Morocco ranges between (5.64%) and (14.37%), which aligns closely with the broader African pooled rate of \ (6.35\% \) [49].
- Regional studies: In the Kenitra province, local cohorts noted macrosomia rates of roughly (7.54%). Further clinical reviews from university teaching hospitals in Casablanca, Rabat, Marrakech, and Fez have consistently observed a climbing trend in the rates of high-birth-weight babies [49].

8.5.2. Primary risk factors in Moroccan women

- Maternal BMI & weight gain: There is a well-documented correlation between maternal obesity and the delivery of macrosomia infants in Morocco. Overweight and obese women exhibit significantly higher rates of macrosomia, with some clinical studies showing that up to (40%) of macrosomia births occur in obese parturient [49].
- Diabetes & gestational diabetes (GDM): Approximately (71.7%) of Moroccan obstetricians identify gestational diabetes and type 2 diabetes as the primary high-risk factors for macrosomia [49].
- Neonate gender: In Moroccan cohorts, male neonates are over (3) to (4) times more likely to be macrosomia compared to females [49].
- Gestational age: Pregnancies extending beyond 40 weeks are a significant predictor, increasing the likelihood of fetal macrosomia by a factor of over (4) [49].

8.5.3. Maternal & neonatal outcomes

- Cesarean sections: The rate of cesarean deliveries among Moroccan women who are overweight or obese is elevated, partly because macrosomia makes vaginal delivery clinically complex [49].

- Birth complications: Macrosomia poses severe delivery risks, such as an increased incidence of postpartum hemorrhage (often due to uterine overdistention), perineal tears, and a higher risk of shoulder dystocia [49].
- Neonatal morbidity: Macrosomia newborns frequently face metabolic complications, notably neonatal hypoglycemia, and may require admission to neonatal intensive care units (NICU) [49].

8.5.4. Clinical guidelines & physician knowledge

A national assessment of Moroccan physicians' knowledge and practices regarding macrosomia highlights gaps in early, prenatal detection. While the majority of practitioners routinely screen for gestational diabetes and obesity, (81.2%) of surveyed doctors encounter fewer than ten macrosomia newborns per week. Official guidance recommends enhanced obstetric preparedness and lifestyle interventions targeting pre-pregnancy weight management. For comprehensive national directives, consult the Moroccan Ministry of Health and Social Protection [49].

8.6. Expand the discussion by critically evaluating the literature and identifying evidence gaps

Current literature critically agrees on the condition's association with maternal and neonatal trauma (e.g., shoulder dystocia and postpartum hemorrhage). However, the research reveals significant limitations in prenatal predictability, universally standardized definitions, and optimal delivery management [49].

Critical evaluation of the current literature is:

8.6.1. The diagnosis and predictive dilemma

- Imprecision of estimation: Literature shows that estimating fetal weight (EFW) before birth—whether through abdominal palpation or ultrasound—is notably imprecise. Ultrasound's margin of error widens as the fetus gets larger, and its ability to accurately predict birth weighs over 4500 g is poor, with a sensitivity rate as low as 33% to 44% [49].
- Retrospective diagnosis: Per the American College of Obstetricians and Gynecologists (ACOG) on Macrosomia, the most accurate method to diagnose macrosomia remains weighing the newborn after delivery [49].

8.6.2. Management controversies

- Induction vs. elective c-section: The literature highlights a divide regarding management. Evidence suggests prophylactic cesarean sections reduce the risk of birth trauma (like brachial plexus injuries) in cases of suspected macrosomia (birth weights \ (> 4500\) g in diabetic mothers, \ (> 5000\) g in non-diabetic mothers). However, routine early induction of labor for suspected macrosomia remains controversial, as it does not reliably decrease cesarean delivery rates or completely prevent shoulder dystocia [41].
- Long-term metabolic consequences: Studies consistently connect macrosomia with immediate complications, such as neonatal hypoglycemia. Furthermore, epidemiological data supports a "U-shaped" or linear relationship between macrosomia birth weights and long-term cardiometabolic issues in offspring,

including childhood obesity, insulin resistance, and type 2 diabetes later in life [41].

8.6.3. Evidence gaps in macrosomia research

Despite the wealth of data, several critical gaps in the literature remain unaddressed [41]:

Lack of a universal definition: There is no global consensus on a precise definition, with thresholds varying widely across regions and institutions (e.g., (4000) g vs. (4500) g vs. the (> 90text{th}) percentile for gestational age as "large for gestational age"). This heterogeneity makes synthesizing multi-center clinical trials and establishing standardized management guidelines incredibly difficult [41].

- Uncertainty in modifiable vs. non-modifiable factors: While risk factors like gestational diabetes and maternal obesity are well-documented, the exact effect size of specific, potentially modifiable variables—such as distinct dietary interventions and targeted gestational weight gain limits—on preventing macrosomia requires more precise, large-scale randomized trials [41].
- Emerging biomarkers and first-trimester prediction: Current prediction strategies are relegated to late-stage diagnostics. There is a growing body of research investigating the predictive utility of early pregnancy biomarkers (such as maternal glycemic markers, adiponectin, or lipidomic profiles in the first and second trimesters). However, the clinical validation and standardized application of these biomarkers are still highly limited [41].
- Racial, ethnic, and global discrepancies: The bulk of foundational literature is based on populations in high-income, Western countries. There are distinct evidence gaps regarding the etiology, prevalence, and threshold-specific risks of macrosomia in diverse, low-to-middle-income healthcare settings [41].

Addressing these gaps requires standardized reporting of birth weight cutoffs, multi-ethnic validation of early diagnostic tools, and further clinical trials on the safety profile of active obstetric management strategies [41].

9. Conclusion

Fetal macrosomia, as a common complication of gestational diabetes, represents a major issue for maternal and neonatal health. The results show that despite the existence of appropriate clinical protocols, prevention remains limited due to low nutritional involvement, a lack of continuous training for the staff, and especially partial adherence of patients to medical recommendations. Moreover, neonatal complications associated with macrosomia, such as respiratory distress and hypoglycemia, confirm the urgency of comprehensive and proactive management. It therefore appears essential to strengthen educational strategies, further integrate nutritionists into follow-up care, and promote continuous training for healthcare professionals. Such an integrated approach would significantly reduce cases of macrosomia and improve the quality of care offered to mothers and their newborns. This new strategy, developed with the support of UNICEF and WHO, places nutrition at the heart of the resilience of the healthcare system (2024–2030).

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