The forgotten father in obstetric medicine

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Abstract

The role of fathers prior to conception, during pregnancy, and in the post-partum period has generally not been a key consideration for Obstetric Physicians. However, this view may need challenging. This paper outlines the key importance of fathers in all phases of obstetric medical care. We review the contribution of paternal factors such as genetics, health, and lifestyle to fetal development, pregnancy complications, and maternal and neonatal wellbeing. The role of fathers in complex care decisions during pregnancy is also reviewed. Postpartum, fathers have a substantial role in shaping the future of the family unit through encouraging breastfeeding and creating a supportive environment for motherhood. This review proposes areas for future research and recommends an evidence-based change in practice in obstetric medicine that focuses on recognizing the role of fathers in the pregnancy journey.

Keywords

Fathers, men's health, preconception

Introduction

Childbirth traditionally has had a focus on the mother and child, almost to the exclusion of paternal participation. With the phenomenon of male partners being increasingly welcomed into antenatal classes and the birth suite,¹ this paper explores health care practitioner considerations for the father. This includes the preconception, antenatal, childbirth, and post-partum periods, with a particular focus on key issues for the obstetric physician.

Preconception

A core component of obstetric medicine is to provide preconception care to women with complex medical conditions. In practice, this includes a detailed history, physical examination, and appropriate investigations.² A holistic approach comprises interventions that aim to identify and modify biochemical, behavioral, and social risk factors.²

Men's preconception health is a novel and equally important consideration for health practitioners with a wide spectrum of benefits.^{2,3} Paternal health is critical in fetal developmental programming and can influence the health of future generations through polygenic inheritance.⁴ The social wellbeing of the father is also critical in providing a healthier environment for the mother and baby unit. This is reinforced by the Centre for Disease Control's (CDC) preconception recommendations for men to address concerns related to nutrition, medical, mental and sexual health history, toxins, environmental exposures, and violence, through consultation with their health practitioner prior to fathering a child.^{2,5}

Better planning and support

Preconception care by health practitioners that involves male partners is critical in facilitating the quality of information available to couples when planning a pregnancy. With over half of pregnancies

being unplanned, the CDC recommends that all couples develop a reproductive life plan.⁵ Preconception counseling for men results in better preparation for parental responsibilities and improved reproductive outcomes for women by encouraging positive perinatal care choices, health-seeking behaviors, and supportive maternal health decisions. Women whose partners were involved in the pregnancy were 1.5 times more likely to receive prenatal care, and women who smoked reduced their cigarette consumption by 36% more when compared to women without partner involvement. Additionally, significantly more women breastfed their child when partners attended the intervention class (74%) compared to those whose partners did not (41%).^{6,7}

Sperm quality

Improved overall health enhances men's biologic and genetic contributions to conception with improved sperm quality. Whilst literature on maternal exposures and risk of epigenetic changes is longstanding, recent animal and epidemiological studies on various contaminants,

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nutrition, and lifestyle-related conditions suggests a paternal influence on the offspring's future health.⁸ These phenotypic outcomes have been attributed to DNA damage or mutations and environmentally induced functional changes of the genome. These changes may be driven by epigenetic components, accumulation of epigenetic changes from chronic exposures, or persistent and heritable modifications to the epigenome demonstrated by trans-generational effects. The effects of environmental insults are not necessarily equal and there is a suggestion of the existence of epigenetic windows during sperm development where DNA methylation, histone modification and non-coding RNAs result in a non-genetic transfer of paternal environmental information.⁸

Advanced paternal age

Advanced paternal age modifies the epigenetic integrity of the sperm and is associated with increased rates of spontaneous miscarriage and child morbidity.⁸ A retrospective analysis of 17,000 intrauterine inseminations found that the clinical pregnancy rate was 12.3% for men below the age of 30 years, and declined to 9.3% for men over the age of 45 years. There was a corresponding increase in the risk of miscarriage from 13.7% to 32.4%.⁹ In addition, when compared to younger fathers of 25 to 29 years, advanced paternal age (>45 years) is associated with an increased risk of adverse pregnancy outcomes. These include a 19% increase in the risk of low birth weight (odds ratio [OR]=1.19, 95% confidence interval [CI] 1.09–1.29), an increase in preterm birth of 13% (OR = 1.13, 95% CI: 1.05–1.22) and a 29% increase in the risk of very preterm births (OR = 1.29, 95% CI: 1.15–1.44) with a substantial (48%) increase in the risk of late stillbirth (OR = 1.48, 95% CI: 1.04–2.10).^{9,10}

As with other cellular processes, the ability to reprogram the epigenome declines with advancing years. This results in pre-meiotic damage to spermatogonia that can introduce new point mutations into the gene pool.⁸ These point mutations can in turn lead to birth defects, neuropsychiatric diseases and an increased risk of malignancy. However, the risks of advancing paternal age are not routinely discussed in prenatal counseling.¹¹

Exposures

Paternal preconception exposure to environmental and occupational factors including heat, radiation and endocrine disruptors are important determinants of sperm quality. Male preconception exposure is associated with poor outcomes including birth defects, malignancies and other developmental concerns.^{12–17} Interestingly, paternal exposure is associated with longer gestational age and larger birth weight. Peri-conception occupational exposure to organic solvents, even in one parent, was associated with an increased risk of having a child with anencephaly (OR= 2.97, 95% CI: 1.36–6.52).¹⁶ In addition, occupational exposures to phthalates in the father was associated with an increased risk of developing a peri-membranous ventricular septal defect (PmVSD) (OR = 1.6, 95% CI: 1.0–2.4) and pulmonary valve stenosis (OR= 2.4, 95% CI 1.1–5.2). Similarly, paternal exposure to alkylphenolic compounds had an increase in the risk of developing PmVSD (OR = 1.5, 95% CI: 1.0–2.2).¹⁴ Exposures to herbicides from residential use contributed to a significantly increased risk of astrocytoma (OR = 1.9, 95% CI: 1.2–3.0).¹³ Furthermore, a recent systematic review and meta-analysis concluded that occupational exposure to pesticides in parents has a statistically significant association for the occurrence of astroglial brain tumors in their offspring (OR= 1.30, 95% CI: 1.11–1.53).¹⁸

When assessing a couple's combined fertility, the exposure to toxins from environmental and occupational exposures must be quantified in both partners. The Longitudinal Investigation of Fertility and the Environment (LIFE) study assessed various

chemical classes and the effect of overall fecundity through time-to-pregnancy (TTP) and fecundability odds ratios (FORs). There were significant reductions ranging from 17% to 31% in a couple's fecundity where partners had elevated concentrations of heavy metals, organic pollutants, environmental phenols and phthalates on urine and blood analysis. Increased levels of lead in the male partner's blood was associated with a reduction in couple fecundity (FOR= 0.83, 95% CI: 0.70, 0.98), and similarly so for tetrahydroxy benzophenone (FOR= 0.69, 95% CI: 0.49–0.97) and monomethyl phthalates (FOR= 0.81, 95% CI: 0.70, 0.94). In particular, male partners' chemical concentrations were consistently more often associated with diminished couple fecundity than female partners' concentrations.¹⁹

Furthermore, a quarter of fathers are likely to take prescription drugs in the three months prior to conception.²⁰ Although the limited data from small studies provides reassurance that paternal drug exposure is not an important risk factor for adverse pregnancy outcomes, large and longer term follow-up studies are necessary to evaluate the risk of rare outcomes, such as birth defects, and long-term effects on the offspring.^{20,21} Table 1 delineates the effect of some drugs on semen quality, sperm motility, and infertility.

Other exposures, including radiation and certain infections, may affect male factor infertility. Data on paternal Zika virus infection have suggested that although spermatogonia are probably the main target, the seminal vesicles and prostate are also likely to be infected for prolonged periods of time.²⁷ Therefore, the World Health Organization (WHO) recommends abstinence or safe sexual practices for at least six months after potential exposure to Zika virus.²⁸

Health behaviors

Male health and lifestyle factors define the paternal genome with the potential to affect male fertility and offspring health. Exposure to tobacco contributes to oxidative damage to the sperm DNA and results in a dose-dependent increase in the incidence of mutations in the sperm from 5.3% in nonsmokers to 19% in irregular smokers and 33% in daily smokers, thus contributing to infertility.²⁹ Smoking is also associated with an increased risk of aneuploidy and structural defects, impaired long-term health of the offspring and serious public health and socio-economic implications for future generations.^{29,30}

In addition to health issues for the father, paternal obesity is a major risk factor for chronic diseases in offspring. Obesity in fathers is associated with preterm birth and impaired spermatogenesis with lower rates of fertility and pregnancy success.^{15,31} Recent studies have explored the inter-generational and trans-generational epigenetic effects in the sperm cells and offspring.⁸ The paternal influence is dependent on the body mass index and the transfer of preconceptional environmental influences through the sperm epigenome.^{8,32} Therefore, weight optimization in fathers prior to conception is an area that needs to be prospectively studied in terms of the impact on child health.

Paternal mental health

Lifestyle stressors and paternal experience across the lifespan can induce germ cell epigenetic reprogramming and impact the offspring's hypothalamic-pituitary axis stress regulation. This has the potential to influence neuropsychiatric disease risk as well as rates of mutagenic oxidized DNA. This effect is reversed with meditation and yoga, highlighting the contribution of lifestyle and social habits on sperm DNA integrity and consequent offspring health.³² A recent interventional study evaluating the effects of exercising in humans reported positive epigenetic changes in the sperm cells after a three-month period of physical exercise.³³ DNA methylation changes occurred in the genes related to diseases such as schizophrenia, Parkinson's

Table 1. Medications associated with male factor infertility.

Drug class	Medication	Mechanism contributing to infertility
Specific serotonin reuptake inhibitors (SSRI) ²²	Combination SSRI Bupropion Sertraline Fluoxetine Escitalopram	Altered testosterone levels Decreased sperm motility Spermicidal effect (in vitro)
	Paroxetine	Sperm DNA fragmentation Erectile dysfunction Difficulties in ejaculation
Calcium channel blockers (CCB) ²²	Diltiazem Nifedipine Non-specified or mixed CCB	Decreased sperm motility and viability in vitro (dose-dependent) Sperm structural changes in head and tail regions Altered sperm binding
Alpha-adrenergic blockers ²²	Tamsulosin Alfuzosin	Antegrade ejaculation Anejaculation Reduced sperm concentration and motility
5-alpha-reductase ²³ inhibitors	Finasteride Dutasteride Propecia	Decreased sperm count, semen volume, sperm concentration and sperm motility
Anti-epileptics ²²	Carbamazepine Valproate Phenytoin	Abnormal sperm morphology Reduced motility Low sperm count Reduced testicular volume
Anti-retrovirals ²²	Saquinavir	Decreased sperm motility (in vitro) Negative effect on essential fertilization mechanisms
	Highly active anti-retroviral therapy	Neuropathy and lipodystrophy Reduced sperm motility Reduced ejaculate volume Increased rates of abnormal sperm morphology
Antibiotics ²⁴	Tetracycline	Reduction in the sperm motility, number of live spermatozoa, sperm counts, and increased abnormal sperm morphology (animal studies) Reduced sperm motility (in vitro)
Chemotherapy ²⁵	Cyclophosphamide	Oligospermia or azoospermia (longstanding/permanent)
Anabolic steroids ²⁶		Oligospermia and azoospermia Abnormal sperm morphology
Phosphodiesterase inhibitors ²²	Sildenafil	Improvement in semen motility, but negative effect on oocyte fertilization

disease, cervical cancer, and leukemia, although it remains to be determined if these changes are inherited by future generations.³³ Furthermore, the results of prospective cohort studies demonstrate the positive association between paternal stress in the antenatal and postnatal period and offspring behavioral dysfunction.^{34–36} On the Strengths and Difficulties Questionnaire, children of 4 to 5 years whose fathers had early depressive symptoms were more likely to score above the 90th percentile in terms of behavioral difficulties

(OR = 3.34, 95% CI: 3.06–3.65) and had a low development and wellbeing score (OR = 2.70, 95% CI: 2.44–2.98).³⁴ In addition, maternal and paternal depression affects child development differently. Early paternal depression was more strongly associated with hyperactivity problems in boys, although it had a stronger association with emotional problems in girls. Therefore, interventions for detection and treatment of depression in fathers at risk are likely to be justified.³⁴

Table 2. Examples of paternal interventions and factors shown to positively impact outcomes for the father, mother, or child.

Reference	Study type	Subjects (number)	Country	Intervention	Findings
Antenatal: Martin et al. ⁶	Longitudinal cohort study	Women and their partners (5404)	USA	Nil (observational)	Women whose partners were involved in pregnancy care were 1.5 times more likely to receive prenatal care and those women who smoked reduced cigarette consumption by 36%
Denham et al. ³³	Longitudinal cohort study	Young healthy men with no previous structured exercise (24)	Australia	Three-month exercise intervention program	Epigenetic changes in sperm cells after involvement in a physical intervention program (DNA methylation at CpG sites in genes associated with a wide range of diseases such as schizophrenia, Parkinson's disease, cervical cancer and leukemia)
Tunc et al. ⁷⁰	Longitudinal cohort study (baseline control)	Men with known male factor infertility (45) compared to fertile controls (12)	Australia	Daily multivitamin/antioxidant supplement for three months	Increased overall sperm DNA methylation and decreased DNA damage with antioxidants. No change in morphology and motility
Håkonsen et al. ⁷¹	Pilot cohort study	Males with a BMI 33–61 kg/m ² (43)	Denmark	14-week residential weight loss program	Weight loss was associated with an increase in total sperm count, semen volume, testosterone, serum hormone binding globulin (SHBG) and anti-Müllerian hormone (AMH).
Charandabi et al. ⁷²	RCT	Spouses of pregnant women with gestational ages of 24–28 weeks followed up until six weeks postpartum (126)	Iran	A two-weekly lifestyle-based training session lasting 60–90 min	The intervention group had a significant decrease in depression and anxiety scores at eight weeks after the intervention, as well as postnatal depression scores
Li et al. ⁷³	RCT	Expectant fathers – first pregnancy (87)	Taiwan	Four-hour birth education program providing information on labor and delivery and suggestions to assist women in labor and relaxation techniques	Significantly decreased anxiety in fathers in the intervention group
Diemer et al. ⁷⁴	RCT	Partners of primiparous and multiparous women (83)	USA	Father-focused discussion in perinatal classes	No effect on paternal stress levels in the antenatal period, but increased paternal coping and support seeking behaviors
Matthey et al. ⁷⁵	RCT	Couples in their first pregnancy (199)	Australia	Antenatal psychosocial intervention session on empathy	Reduction of postpartum distress at 6 weeks postpartum in mothers with low self-esteem and increased awareness in the men regarding their partners' needs

(continued)

Table 2. Continued

Reference	Study type	Subjects (number)	Country	Intervention	Findings
Postnatal:					
Wolfberg et al. ⁷	RCT	Partners of women who were booked in to give birth (51)	USA	A 2-h class on infant care and breastfeeding compared to a class on infant care only	Significant improvement in breastfeeding initiation rates
Alio et al. ¹⁰	Retrospective cohort study	755,334 fathers classified into age brackets: <20 years, 20–24 years, 25–29 years, 30–34 years, 35–39 years, 40–45 years, and >45 years	USA	Nil (observational)	Fathers aged 25–44 years had lower risk of children with low birth weight and partner with preterm labor compared to those aged <25 years and >44 years; fathers of advanced paternal age (>45 years) had a 48% increased risk of late stillbirth
Deutsch et al. ⁷⁶	Longitudinal cohort study	Children 10–11 years of age (40)	USA	Nil (observational)	Children who experience intimate parental relationships and have fathers who contribute a high proportion of the caretaking that is attentive, firm, and emotionally involved have higher self-esteem than other children
Cox et al. ⁷⁷	Longitudinal cohort study	Married couples at three months post-partum (38)	USA	Nil (observational)	Sensitive, warm, and appropriate interactions of fathers with their 3-month-old babies resulted in secure attachment of the babies to their fathers
Easterbrooks et al. ⁷⁸	Longitudinal cohort study	20-month-old children and their parents (75)	USA	Nil (observational)	The extent of fathers' involvement was related to toddler development in qualitative attitudes, such as behavioral sensitivity. Positive parenting attitudes and behaviors contributed to toddlers being more securely attached and competent at a problem-solving task
Koestner et al. ⁷⁹	Cross-sectional study	31-year-old subjects (37 men and 38 women)	Canada	Nil (observational)	Paternal involvement at age 5 was a significant predictor of empathic concern for others at age 31
Goncy et al. ⁸⁰	Longitudinal cohort study	Adolescents in grades 7 to 12 (9148)	USA	Nil (observational)	Shared communication and emotional closeness to fathers had an impact on adolescent alcohol use, above and beyond maternal involvement
Cookston et al. ⁸¹	Longitudinal cohort study	Adolescents in grades 7 to 12 (2387)	USA	Nil (observational)	Father involvement was a significant predictor of adolescent depressive symptoms. Considerable stability was observed in the relation between father involvement and child adjustment

RCT: randomized controlled trial.

This issue becomes increasingly important as the transition to fatherhood involves numerous stressors associated with fundamental shifts in roles and relationships.³⁷ Psychological morbidity for fathers' peaks in the perinatal period from conception to one-year post-partum with a significant prevalence of depression (5–10%) and anxiety (5–15%).³⁸ A recent updated meta-analysis has suggested that rates of depression are highest in the 3 to 6 months post-partum (13%, 95% CI: 7.2–22.3).³⁹

The primary period of increased paternal depressive symptoms is in the child's formative first five years of life.³⁶ Whilst the reported paternal postpartum depression rates are about half the maternal rate, this is likely to be biased due to underreporting by men.³⁶ Paternal mental health and wellbeing is also important due to the buffering effect of maternal stress on child development.^{40,41} This suggests a role for routine paternal screening and interventions. In addition, there is evidence to show that postpartum educational programs are more effective when they involve both partners.^{42,43} This is particularly important after severe adverse events such as postpartum hemorrhage and shoulder dystocia, where men are often bystanders and generally ignored.⁴⁴

Antenatal

Pre-eclampsia. Pre-eclampsia is a significant contributor to maternal and neonatal morbidity and mortality worldwide.⁴⁵ It is a disease caused by complex pathophysiological mechanisms including genetic, environmental, and epigenetic factors. A recent emerging theory has suggested that a failure of the adaptation of the maternal cardiovascular system may lead to impaired uterine perfusion, resulting in end-organ damage and inadequate trophoblast invasion.⁴⁶ In addition, it has also recently been recognized that pre-eclampsia is a "couple's disease". The male partner has been classified as the "dangerous partner" due to passing on genes that may adversely affect the pregnancy outcome.⁴⁷ Men who previously fathered a pregnancy complicated by pre-eclampsia are twice as likely to contribute to pre-eclampsia in a pregnancy with another woman.⁴⁷ The only meta-analyses exploring paternal factors investigated the contribution of anti-paternal human leucocyte antibodies (HLA) and suggested that human leukocyte antigen G (HLA-G) expressed on the invading cytotrophoblast is important for the maternal adaptation of the placental vessels.⁴⁸ A shorter duration of exposure to seminal fluid is responsible for an increased risk of developing pre-eclampsia.⁴⁷ This is also demonstrated by an escalated risk of pre-eclampsia in pregnancies conceived as a result of ovum donation in azoospermic partners and after a short duration or a single act of unprotected intercourse.^{49,50} The paternal antigens evoke a maternal immune reaction and prolonged exposure to the seminal fluid results in maternal mucosal tolerance. This protective effect is lost when there is an increased inter-pregnancy interval, even with the same partner. This increased duration is a higher risk factor for pre-eclampsia than a new partner.⁵¹ Additionally, the use of barrier contraceptives increases the incidence of pre-eclampsia, while oral sex acts as another mechanism to increase maternal mucosal tolerance to paternal antigens decreasing the risk of pre-eclampsia.^{51–53} The risk of pre-eclampsia is lower with Asian paternity, although discordance of parental ethnicity increases the risk.⁵⁴

Furthermore, studies on paternal family history of genetic thrombophilia, hypertension, and cardiovascular disease reflect genes passed through the feto-placental unit via the father, which are associated with a number of adverse pregnancy outcomes.⁴⁸ This may be through single-nucleotide polymorphisms in the paternally expressed insulin-like growth factor (IGF2), which is responsible for trophoblastic invasion and placental function.⁴⁸ Likewise, there are several other possible pathways by which certain viruses, such as cytomegalovirus (CMV) and herpes virus, bacterial, fungal, and parasitic

infections, have the potential to contribute to adverse pregnancy outcomes and, more specifically, to pre-eclampsia.⁴⁷ Herpes, in particular, is associated with an increased risk of developing pregnancy-induced hypertensive disorders.⁵⁵ CMV is known to have a major reservoir in the male urogenital system and could change the cytokine levels in seminal fluid. This would adversely affect the partner-specific mucosal tolerance and impair aspects of cytotrophoblast function, including decreased HLA-G expression and alterations in IGF2.^{47,48}

Whilst a significant effort is made by obstetric physicians to recognize and treat women at high risk of pre-eclampsia, there is no routine approach to identify pregnancies fathered by a higher risk partner. Furthermore, there appears to be a significant gap in the level of counseling provided to both male and female partners on current and future pregnancy risks specific to shared medical histories. Simple interventions like providing written information such as the CDC factsheet (2018) on "Information for men" may provide an opportunity to intervene by engaging prospective fathers prenatally.⁵

Stillbirth. Worldwide, more than 2.7 million babies are stillborn each year.⁵⁶ Stillbirth is associated with significant and variable grief reactions from both parents and their families, resulting in an ongoing strain on interpersonal relationships.⁵⁶ The consequences of stillbirth can also negatively affect subsequently born children.⁵⁶ Even in higher income countries, support services focus on the mother and the impact on fathers is less well described, with most literature recording second-hand accounts from women regarding their partner's reaction.⁵⁷ Qualitative findings demonstrate that fathers display a classical grief response, but their experiences often relate to the expectations of being the "strong one", with particular prominence of grief suppression, increased substance use, employment difficulties, and financial debt compared to mothers.⁵⁶ Men appear to struggle with anxiety and depression, as well as possible post-traumatic stress disorder (PTSD) following stillbirth, but are reported to have lower rates of these complications compared to mothers.⁵⁷ The sense of grief and loss can be so overwhelming for fathers that they may choose not to participate in the birth of their stillborn baby.⁵⁸ Healthcare providers need to be conscious of providing counseling that takes men's needs into account.⁵⁹

Evidence-based guidelines for the care of families after a stillbirth recommend the development and implementation of meaningful, non-pharmacological care strategies, which includes attending to the needs of the father.⁶⁰ Appropriate training is required for all staff involved in providing care to reduce the psychosocial impact of stillbirth and assist parents in developing resilience.^{56,61} The importance of the social role of fathers in supporting their partner in difficult circumstances requires recognition and further encouragement.^{62,63} In pre-conception counseling, emphasis should be provided towards caring for fathers who have experienced adverse pregnancy outcomes, as they may be hesitant to embark on another pregnancy. Anxiety levels in fathers increase after a fetal loss (15.6% had PTSD), especially when there is a greater inter-pregnancy interval.⁵⁷ In a pregnancy subsequent to fetal loss, fathers experience significant levels of anxiety and PTSD in the antenatal period, although these remit after the birth of a live baby.⁵⁷ While at all time points fathers' symptom levels appear lower than those of mothers, this is an area requiring further research and increased acknowledgement of its unique manifestations.⁵⁷

Post-partum period

Breastfeeding

Breastfeeding has been shown to provide immediate and long-term benefits for both mother and children. Despite this, breastfeeding

rates remain suboptimal and the reasons include a lack of knowledge and support from the immediate family and the larger community, conflicting information, mechanical issues, complications, and logistics.⁶⁴ While social and behavioral change made breastfeeding more acceptable in public areas, the role of the father is often ignored as a potential promoting factor.⁶⁵ In addition, health professionals and broader care services often fail to engage fathers in supporting breastfeeding. In a 2013 Puerto Rican study of 84 volunteer fathers, the majority (88%) wanted their partners to breastfeed.⁶⁶ Contrastingly, some fathers had negative views and attitudes with 17% perceiving that breastfeeding is detrimental to breast health and 26% of the belief that it impacts breast appearance.⁶⁶ Furthermore, 7% of fathers reported feelings of jealousy and separation from the baby with the breastfeeding experience, which was identified as an important reason for the early discontinuation of breastfeeding.⁶⁶

Sherriff et al.⁶⁷ delineated a model of father support in breastfeeding with the focus areas of enhancing knowledge, promoting a positive attitude, involvement in decision-making, and practical and emotional support towards breastfeeding. This model highlights entry points for practitioners to develop meaningful strategies to proactively engage fathers from different backgrounds in supporting breastfeeding.⁶⁷ Fathers with lower levels of education, lower disposable household income, or those not on paternity leave during the infant's first year of life were significantly less likely to have partners who breastfeed despite the cost benefits involved.⁶⁸ The published literature highlights increased rates of breastfeeding associated with paternal education and further research about how to best engage men in this process is required.^{68,69}

Conclusion

As the emphasis in obstetric medicine increasingly shifts from the mother and child to the whole family unit, the integration of men's health as a part of preconception, pregnancy, and postpartum services is critical. Given that men's role in this journey has been largely neglected, it may be time for obstetric physicians to embrace the opportunity to more consciously provide health care to fathers. The research into the role of men in pregnancy health and long-term infant outcomes is less prominent than for women. There is very little evidence-based information to guide care for men at this critical time of their lives. Some paternal interventions shown to positively impact maternal-child outcomes are summarized in Table 2. Undoubtedly, this is an important challenge for the obstetric medicine community.

Suggestions for further research and health care delivery

- Establish male-specific guidelines on pre-conception, antenatal, and postnatal care with corresponding training for health care professionals.
- Assess the impact of pre-conception counseling that involves men on maternal, neonatal, and paternal outcomes.
- Explore the paternal contribution and pathophysiological mechanism to offspring health.
- Determine the health benefit impact of positive male behaviors, such as weight optimization and smoking cessation, on pregnancy outcomes.
- Investigate the effect of obesity, diet, and exercise on sperm epigenetics and the effect on future offspring.
- Pilot the role of a paternal health medical record.
- Determine postpartum paternal health outcomes, such as paternal mental health following normal and abnormal births.

- Explore evidence-based interventions and maternal-paternal factors that may reduce the psychosocial cost of stillbirth.
- Develop training models for healthcare professionals to optimize support for families who have had a difficult pregnancy, stillbirth, or bereavement from a fetal or neonatal death.

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