Editorial

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Exploring the mysteries of reproductive health

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Reproductive health is an important factor in coordinated development of the population, economy, and society and has attracted increasing global attention. Reproductive health is also among the core contents of China's population health strategy, and improving maternal and child health is a central component of realizing the Healthy China 2030 agenda [1]. Currently, the population of people in China who are fertile and of childbearing age is decreasing, and the incidence of birth defects is high. Therefore, determining the molecular basis of fertility establishment and maintenance as well as the physiological and pathological regulation mechanisms of fertility are theoretical cornerstones for further understanding life. This information can also be used to diagnose and treat various reproductive-related diseases, effectively improve infertility, and improve the health of children. The key steps of the reproductive process include gamete development, maturation, fertilization, early embryo development, embryo implantation, and pregnancy maintenance. Research on fertility and reproductive health involves analysis of the physiological regulation mechanism of each step of reproductive development, various diseases and birth defects caused by disorders in reproductive development, and the programming mechanism of offspring health in both the short- and long-term (Figure 1). In this issue, several outstanding scientists summarize recent research progress in studies of reproductive health from various perspectives to provide an overview of the frontiers and trends in this field.

Infertility

The infertility rate of people of child-bearing age in China is 12%–18%. Infertility is regulated by multiple factors and has a complex pathogenesis. (1) Male infertility can be caused by semen abnormalities (oligospermia, asthenospermia, azoospermia, sperm development arrest, teratospermia, etc.), male sexual dysfunction, and other factors such as immune-related conditions. Gene mutations have an important influence on spermatogenesis in humans. Environmental factors, such as endocrine-disrupting chemicals found in the environment, also affect spermatogenesis. (2) The factors influencing female infertility include abnormalities in oogenesis and ovulation as well as conditions affecting the pelvic cavity (fallopian tube lesions, uterine body lesions, cervical lesions, endometriosis, etc.). Polycystic ovary syndrome and premature ovarian insufficiency are primary diseases leading to female infertility and show obvious familial inheritance. The ovarian reserve is also a critical component of a woman's fertility and is involved in healthy aging. A reduced number of follicles and decreased quality of oocytes lead to decreased fertility, possibly through decreased chromosome cohesion and chromosome misalignment, telomere shortening, DNA damage and associated genetic mutations, oxidative stress, and mitochondrial dysfunction. (3) The etiology of unexplained infertility (potential factors include immune factors, recessive fallopian tube factors, fertilization disorders, embryo implantation failure and genetic defects) is difficult to determine because targeted clinical testing methods are lacking.

Embryonic development

In addition to infertility, pregnancy failure, abortion, stillbirth, and pregnancy-induced hypertension, gestational diabetes mellitus, and premature delivery in pregnant women can cause serious harm to maternal and infant health. Numerous pregnancy-related diseases often arise

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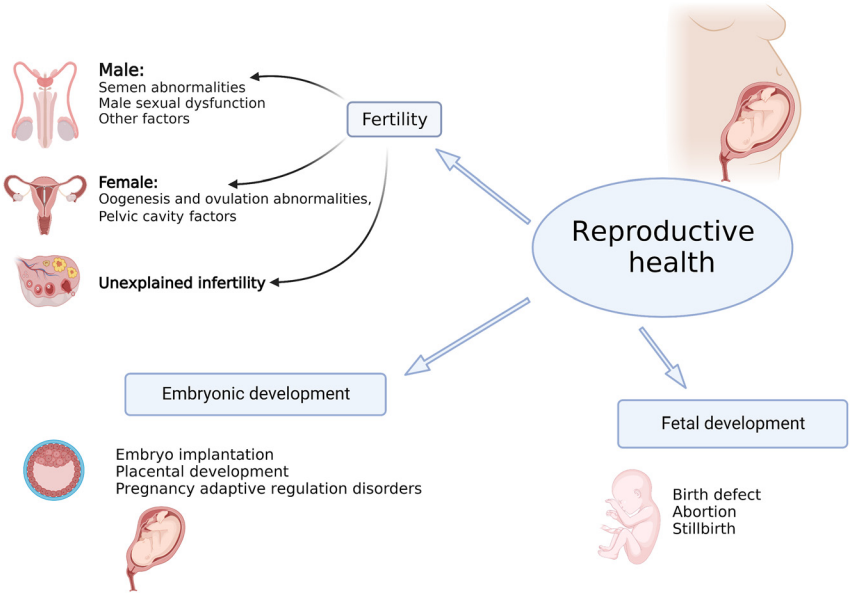

Figure 1: Physiological regulation mechanisms involved in reproductive health.

from disorders in embryo implantation, placental development, and pregnancy adaptive regulation [2]. The placenta is a semi-permeable barrier that enables material exchange between the mother and fetus and is essential for fetal growth and development. The implantation process is intricately regulated to ensure maternal tolerance to the fetus and placenta. The placenta as well as transporters expressed in the placenta are critical for determining fetal drug exposure. Understanding placental drug transport and its correlation with fetal drug exposure is essential for optimizing the therapeutic use of drugs in pregnant women and their fetuses to ensure efficacy and low toxicity [3]. Recurrent pregnancy loss is an important reproductive health problem worldwide and is widely regarded as a multifactorial disease. Genetic factors and maternal immune disorders are considered as the two most important causes of recurrent pregnancy loss. An abnormal chromosome number or structure in sperm and sperm DNA fragmentation may also lead to low fertilization rates, embryo arrest, and abortion [4]. In recent years, great progress has been made in the development of organoid culture systems that can be used to simulate the *in vivo* conditions of embryo development and obtain a detailed understanding of basic human developmental biology [5].

Fetal development

Birth defects seriously affect the development of families and society. Most fetuses with severe birth defects have genetic defects, and many birth defects are rare genetic diseases. Preimplantation genetic testing, preimplantation genetic diagnosis, preimplantation genetic screening, and other technical platforms are important technical solutions for selecting embryos with implantation and fertility potential or embryos without genetic material abnormalities. These methods can improve the success rate of assisted reproduction and reduce birth defects. In recent years, genome editing technology has advanced and been applied to treat inherited diseases [6]. Developments in genome editing technology have allowed DNA sequences to be permanently altered in a site-specific manner, offering promising approaches for treating human diseases caused by gene mutations. Numerous studies have suggested that epigenetic modification plays a crucial role in the occurrence of developmental adult diseases and is expected to be targeted in approaches aimed at treating human diseases [7].

Prospects

Rapid research advances in the field of reproductive health in China has made great contributions to improving fertility and reproductive health. In recent years, the innovation and development of multi-disciplinary techniques have been successfully applied in studies of reproductive medicine, resulting in a series of significant achievements. However, the mechanisms of many diseases are unclear and thus require further analysis. In addition, in-depth

studies are needed to combine basic and clinical research and translate laboratory findings into clinical applications to promote the reproductive health of China and the world.

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