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The Advance of Maternal Health and Fetal Outcomes

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Abstract. Maternal health and fetal outcomes have become one of the global public health issues. Among all factors, maternal nutrition and psychological stress play the significant role in the physical and mental health of newborns. Improper nutrition or excessive psychological stress may lead to a series of adverse pregnancy outcomes, such as congenital malformations, neuropsychological defects and mental disorders, such as autism (AD), schizophrenia and attention deficit / hyperactivity disorder (ADHD). Clinically, it can be intervened in a variety of ways. In terms of nutrition, such as folic acid, docosahexaenoic acid, choline and leucine, it can be supplemented with multiple nutrients. In terms of psychology, it can be family-based intervention and mindfulness-based plan to alleviate maternal stress and maternal depression. Most of the clinical studies tend to supplement nutrition or psychological intervention. The research on combination therapy needs to further explore its clinical effectiveness and whether it can achieve the effect of one plus one more than two.

Keywords: pregnancy wellness, prenatal nutrition, fetal outcome, mindfulness

1. Introduction

Preconception care and prenatal care are important measures to reduce the incidence and mortality of maternal and perinatal complications and reduce birth defects. Through standardized pregnancy health care and prenatal examination, it is possible to prevent and treat pregnancy complications and complications as early as possible, discover fetal abnormalities in time, assess the safety of pregnant women and fetuses, determine the delivery time and mode, and ensure the safety of mother and child. As the 2030 Agenda for 17 Sustainable Development Goals (SDGs) was adopted by the General Assembly in September 2015, all 193 United Nations aimed to achieve them by 2030. Within these goals, maternal health and fetal outcomes lie under Goal 3 which focuses on Good Health and Well-being. Through this goal, all member states of the UN aim to ensure the health condition as well as promote well-being for people of all ages. Since the concept of fetal origin of adult diseases (FOAD) hypothesized that intrauterine environmental exposure such as nutrition and metabolic status can affect the development of fetus and increase the risk of specific disease in the adulthood, factors such as nutrition and psychological health can be intervened in order to improve both maternal health and birth outcomes [1].

Nutrition during pregnancy should not only meet the physiological needs of pregnant women and the needs of fetal development, but also prepare for delivery and lactation. Studies have shown that the development of the fetus in the uterus is closely related to the health of the adult. Therefore, nutrition balance during pregnancy is very important and is the basis for ensuring the health of mother and baby.

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Previous research has found that maternal nutrition may be a factor which can alleviate the risk of pregnancy-related mortality [2]. Moreover, affected by uterine contraction pain during childbirth, maternal have physiological stress reaction, which stimulates the emotional level, leading to neuroendocrine disorders of pregnant women, anxiety, depression and other negative emotions. Especially for primiparas, they are more likely to have negative emotions due to less knowledge of pregnancy and heavy psychological burden, resulting in faster heart rate, higher blood pressure, lower coordination, and ultimately adverse pregnancy outcomes, which means maternal psychological distress may be another factor which can influence the risk of adverse outcomes in children such as Autistic Disorder, Schizophrenia, and ADHD [16-18]. Docosahexanoic acid, choline, and leutin as nutritional interventions can help reduce postpartum depression as well as improve brain and neuretinal condition of the fetus. Moreover, family-based intervention and mindfulness-based programs show significance in decreasing maternal stress and depression. Thus, from the perspective of nutrition and psychological intervention, this paper focuses on the interventions from different fields to improve maternal health and fetal outcomes.

2. Maternal nutrition and psychological factors lead to adverse pregnancy outcomes

2.1. Maternal nutrition

Pregnancy is the initial stage of the 1000-day chance window in early life. Nutrition, as the most important environmental factor, will have a significant impact on both the short-term and the long-term health of mother and baby.Therefore, on the basis of non-pregnant women, the diet of women in various stages of pregnancy should be properly adjusted according to the fetal growth rate and the changes of maternal physiology and metabolism. In the early stage of pregnancy, the growth and the development of the fetus is relatively slow, and the nutrition required is not much different from that before pregnancy. From the second trimester of pregnancy, the growth and development of the fetus is slowly becoming faster, and correspondingly, the development of the maternal reproductive organs is also gradually accelerating.The need for nutrition is increased, and the intake of food should be reasonably increased. The diet of pregnant women should still be a nutritionally balanced diet composed of diversified foods. In addition to ensuring the nutritional needs of pregnant women, it also imperceptibly affects the acceptance of complementary foods by older infants and the establishment of a diversified diet structure. Maternal physical and nutritional conditions during pregnancy relate to the outcome of the newborns in different perspectives as the fetus grows and develops in the uterus while absorbing energy and nutrition from the placenta of mother.

2.1.1. Deficiency of multiple micronutrients. Human nutrients include macronutrients and micronutrients. The former is also called productivity nutrients, including fat, protein and carbohydrate; The latter includes various essential vitamins and minerals, most of which cannot be synthesized by themselves and can only be ingested through the outside world. Inadequate dietary iron intake during pregnancy is likely to lead to iron deficiency anemia or iron deficiency in pregnant women and infants. Iron deficiency anemia is a global public health problem, especially common in less developed countries and regions. If the placenta is lack of oxygen, it is easy to develop hypertensive disease of pregnancy and hypertensive heart disease of pregnancy. Iron deficiency and anemia also reduce the resistance of pregnant women and lead to the weakness of the maternal body. It is easy to be complicated with puerperal infection, postpartum hemorrhage, heart failure, and even life-threatening [3].

Some comparative studies showed that supplementation of multiple micronutrients containing 0.8mg folic acid could reduce the risk of the NTDs by about 92% (OR = 0.08, 95% CI: 0.01-0.47). It was also found that it could significantly reduce the risk of birth defects other than NTDs by about 47%, including the risk of congenital heart disease by 43%, the risk of urinary tract defects and pyloric stenosis by 44% and 80%, respectively [4].

Cobalt, nickel and lead are metals which are contained in women urine samples. Cobalt is an essential trace metal element for human body. It can stimulate hematopoiesis, promote the synthesis of

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hemoglobin, promote the development and maturation of the red blood cells, and increase the red blood cells number. Lower sociodemographic populations will have higher exposure to toxic metal elements as well as lower intake on essential micronutrients [5,6].

2.1.2. Obesity and underweight at time of conception. In recent years, overweight and obesity have become public health problems in developed countries and some developing countries. Maternal obesity will increase the risk of pregnancy related complications. This is because the retention of fat, water and sodium in the body of pregnant women will continue to rise, resulting in the increase of body weight, and the content of insulin receptor in adipose tissue is very low. Regardless of whether they are pregnant or not, obese women had a significantly higher risk of impaired glucose tolerance than normal-weight women. After pregnancy, the placenta of women will secrete a large amount of antagonistic insulin hormone and placental insulin enzyme, which is a lysozyme that will degrade islet hormone and convert it into amino acids and peptides, thus losing the original activity and increasing the risk of diabetes in pregnancy.

Since high hemoglobin A1C level is a marker for hyperglycemia, it can lead to higher rates of miscarriages and congenital deformities. Thus, women who have pregestational diabetes mellitus (GDM) should reach euglycemic before conception. At the same time, the unbalanced growth of body weight during pregnancy will also lead to the occurrence of adverse pregnancy outcomes. The reasons are: first, the traditional experience: overemphasis on pregnancy preparation and supplementary nutrition during pregnancy has led to an increase in the proportion of overweight and obese women before pregnancy. At the same time, the rapid growth of body weight during pregnancy will inevitably increase the probability of adverse pregnancy outcomes to a certain extent; Second, unbalanced nutrition intake, including different regions, individual dietary habits and structures, and inadequate nutrition management and education before and during pregnancy, may lead to overweight, obesity and unreasonable weight gain during pregnancy, and also increase the probability of adverse pregnancy outcomes. Oppositely, underweight women at the time of conception are related to higher risk for preterm delivery and the small gestational age (SGA) infants [1].

2.1.3. Toxic and harmful substances. Maternal health should avoid exposure to toxic and harmful substances in the living and occupational environment (such as radiation, high temperature, lead, mercury, benzene, arsenic, pesticides, etc.), and avoid close contact with pets. Fetal intrauterine exposure to toxic substances will have an impact on the fetal growth and the development. The exposure of these harmful substances may lead to continuous changes in maternal health and have a profound impact on the health of offspring in adulthood. In recent years, prenatal mercury exposure and its adverse effects on fetal growth have grabbed attention from the society. Mercury and its compounds, especially methylmercury, can quickly cross the placenta and the blood-brain barrier, resulting in the higher mercury levels in the fetus than in the mother. Therefore, the fetus is more vulnerable to mercury toxicity. As metal and industrial pollutants can accumulate in the seafood along the food chain, a cohort study conducted in Faroe Island and New Zealand concluded that the exposure of mercury-contaminated fish during pregnancy is associated with neuropsychological deficits [7].

2.2. Maternal stress

Pregnancy and childbirth are a huge physiological change and psychological stress process for primiparas. Due to the change of endocrine environment, the psychological fluctuation of primiparas is also obvious, and the psychology is often fragile. In serious cases, postpartum depression may even occur, which is not conducive to the health of mothers and infants. Some studies have shown that psychological changes will cause vasospasm, which will further affect hormone secretion, renal blood flow and fetal blood circulation, which is not conducive to fetal intrauterine growth and development. Pregnancy can be stressful in different ways, but either can lead to an increased risk of an adverse pregnancy [8].

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2.2.1. Fetal brain development. Under the condition of pregnancy distress, maternal glucocorticoid often increases concentration and crosses to the fetus [9]. The overexposure of glucocorticoid on the fetus from maternal stress can be one of the factors which affects brain development of the offspring. Clinical studies have reported that excessive intake of glucocorticoids may have long-term effects on the function of hypothalamus pituitary adrenal axis (HPA) in offspring, and it is irreversible [10]. With the dysregulation of HPA-axis, stress-related disorders such as depression can be the outcomes of this condition [11].

2.2.2. Autistic Disorder (AD). Autism is a group of neurodevelopmental disorders characterized by social communication disorder, language and nonverbal communication disorder, narrow interests and rigid behavior repetition [12]. By analyzing the data of 65928 samples, the results show that, prenatal stress exposure is positively correlated with autism in young children Thus, the effect of prenatal stressors on autism of offspring is more severe than individuals who did not experience prenatal stress [13].

2.2.3. Schizophrenia (SSD). Schizophrenia disorder is a type of mental disorder which can affect the way an individual thinks, feels, and behaves [14]. Although maternal psychosocial stress is not statistically significant on the odds of SSD in offspring, daily life stress shows significance on increasing odds of SSD on male offspring (OR=1.995, p=0.032) [15].

2.2.4. Attention-deficit/hyperactivity disorder (ADHD). ADHD is a neurodevelopmental disorder which shows the inattention, the hyperactivity, and the impulsivity as the symptoms of the disorder. Under a logistic regression analysis, subjects with patients with positive and the non-ADHD siblings were studied. Through these data, maternal stress during pregnancy revealed significance on ADHD of offspring (OR=6.29, p=0.01) and child's gender (OR=16.35, p<0.01) [16].

3. Interventions on maternal health

3.1. Maternal nutrition intervention

As nutrition can affect maternal health and fetal outcome, it can be implemented as interventions to help solve the problems it brings.

3.1.1. Folic acid. Folic acid deficiency or the use of folic acid antagonists (abortions, antiepileptic drugs, etc.) in early pregnancy can cause stillbirth, abortion or fetal brain and neural tube development malformations.

3.1.2. Docosahexaenoic acid (DHA). Eicosatetraenoic acid (EPA) and DHA are the types of the polyunsaturated fatty acid which are among the chain of PUFA and primarily found in marine fish. Studies have shown that the consumption level of seafood has an impact on the occurrence of postpartum depression. High consumption level can reduce the risk of postpartum depression to a certain extent (r=-0.75, p<0.0001, n=22). The same is true in breast milk. If DHA content is high, postpartum depression is less likely (r=-0.84, p<0.0001, n=16) [17]. Thus, DHA plays a significant role in supporting positive maternal mood and decreasing the risk of psychological problems in the pre and postnatal periods [18].

3.1.3. Choline. Choline is the precursor of acetylcholine, phospholipids and glycine trimethyl internal salt. As a folate independent methyl group, choline participates in the methylation of homocysteine in the liver.so that it is important to neural and brain development. By adding water-soluble choline into

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the regular maternal diet, brain development of the fetus can be improved through different hippocampal characteristics [19]. Therefore, for pregnant women, the dose was set at 450 mg per day.

3.1.4. Phytonutrient lutein. Phytonutrient lutein is an antioxidant compound. Using lutein as a dietary supplement during pregnancy can improve neuroretinal condition of the newborns especially for the children who are at the risk of the retinopathy and the loss of the vision [20].

3.2. Maternal psychological intervention

Besides maternal nutritional intervention, psychological intervention during pregnancy can also be implemented as an intervention to stable maternal mental state. NICE conducts systematic and standardized training for medical personnel on the symptoms, clinical diagnosis, scale score and other contents of pregnant women's psychological state during pregnancy, especially for medical personnel who provide health care information to pregnant women, such as obstetricians, outpatient midwives and antenatal Educators.

3.2.1. Family-based intervention. Through this intervention, the researchers aim to examine its effects on both mother and the infants through: 1) meet the needs for parents and the infant; 2) improve the parenting as well as family factors that can affect fetal development [20].

As a way to observe the effect of family-based intervention on maternal stress, Prenatal Stressor Scale: Neonatal Intensive Care Unit and Maternal Self-Report Inventory (PSS: NICU and MSRI) were used as forms of questionnaires which were completed after the intervention. Though the data from the questionnaires, there was a significance for the effect of intervention on PSS: NICU Sights and Sounds subscale ($P < 0.05$), Infant Appearance and Behavior subscale ($P < 0.05$), and the Total Stressor Score ($P < 0.05$) [20]. Moreover, mothers reported higher levels of self-esteem during pregnancy in the MSRI than at baseline. Thus, family-based intervention is associated with lower maternal stress and higher self-esteem.

Through the Beck Depression Inventory (BDI), the incidence of postpartum depression was significantly reduced when the intervention was used, which was better than the group without the intervention (11% vs.44%) [20]. Thus, family-based intervention can lower the level of maternal depression.

3.2.2. Mindfulness-based programs. In the 1970s, professors at the Massachusetts Institute of technology took the lead in introducing mindfulness into the medical field, it is defined as "a state of consciousness without judgment generated by focusing on the current goal. Subsequently, relevant scholars summarized the operational definition of mindfulness on this basis, that is, mindfulness is to purposefully change attention from perceiving involuntary inner activities to paying attention to the current experience, and maintain a curious, open and receptive attitude towards the current experience. Mindfulness-based programs are the practices of focusing on the present without any unrelated thoughts or emotions [21]. Through these programs, prenatal psychological stress can be reduced and maternal psychological health can be improved.

3.2.3. 6-week Mindful Awareness Practices (MAPS) program. By performing the MAPS program weekly on the pregnant women with the 10-25 weeks($n=47$), the result revealed a significant decrease in Perceived Stress Scale (PSS) and Pregnancy-Specific Anxiety (PSA), and general anxiety (STAI) in the intervention group from baseline to 6-week follow-up ($p<0.05$) [26].

3.2.4. 10-week mindfulness yoga (M-Yoga). After practicing mindfulness yoga (M-yoga), there was the obvious negative correlation between the pre depression and the post mindfulness. The same negative correlation between pre mindfulness and post-depression was shown as well. The negative correlations

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demonstrated that these two groups of data were inversely related. And these relations were significant ($p<0.05$). Thus, M-yoga is significant in reducing depression and increasing mindfulness [22].

In the process of psychological intervention, medical staff should put forward different intervention measures according to the different symptoms, clinical diagnosis and scale scores of pregnant women's psychological state during pregnancy, analyze the influencing factors that cause adverse psychological state during pregnancy, carry out hierarchical management, and take personalized intervention measures. The intervention methods should be diversified, such as one-to-one psychological counseling, group discussion, distribution of mental health education manuals, regular psychological assessment, regular telephone follow-up, family visit and so on.

4. Conclusion

Malnutrition or excess of maternal nutrition during pregnancy will affect the maternal and even the newborn. Obesity and overweight will affect the uterine contraction during delivery, while less nutrition intake will limit the maternal anemia and affect the growth of the fetus. In addition, the maternal neuroendocrine and circulatory system are significantly changed during pregnancy, so it is very easy to cause maternal anxiety, depression and other adverse emotions, and eventually lead to abnormal development Autistic, etc. Through the implementation of individualized guidance, nutritional intervention and psychological intervention during pregnancy during the perinatal health care of pregnant women, the psychological state of pregnant women and the health of newborns can be significantly improved, and the occurrence of adverse pregnancy outcomes can be reduced. For further study, the effect of nutritional and psychological intervention combined need to be studied and analyzed to provide a better solution on the issue of maternal health and fetal outcome.

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