International Journal of
Life Sciences
International Peer Reviewed Open Access Refereed Journal

Int. J. of Life Sciences, 2021; 9 (1):35-40
ISSN:2320-7817(p) | 2320-964X(o)

Review Article Open Access

Influence of natural-disaster related stress on maternal and child health

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Manuscript details:

Received: 25.02.2020
Accepted: 27.03.2021
Published: 31.03.2021

Cite this article as:
Banerjee Maitrayee and Das Dolan (2021) Influence of natural-disaster related stress on maternal and child health., *Int. J. of Life Sciences*, 9 (1):35-40.

Available online on http://www.ijlsci.in
ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

ABSTRACT

Natural disasters impart crucial threats to the health, personal security and livelihood of individuals, communities and societies. The impacts of climate-related disaster are most harshly experienced by people living in low-income and middle-income countries who have a higher dependence on natural resources and who are exposed to higher rates of socioeconomic disadvantage. Humanitarian emergencies ensuing from natural disasters have significant health problems, including reproductive health issues. Improvement of maternal and fetal health, neonatal and children well-being is one of the important socioeconomic targets of the developing countries worldwide. Fetal exposure to prenatal and maternal stress can have lifelong consequences. Different types of maternal stress are associated with different areas of child development. Natural disasters are now become very frequent throughout the world and concern is increasing that they may badly affect short and long term health outcomes. Maternal psychological stress and trauma are more pronounced when pregnant mothers experience natural disasters like earthquake, floods, hurricanes, fires etc. Women become both victims and the primary caretakers. Pregnant women exposed to natural disasters are at risk of depression, anxiety, post-traumatic stress disorder (PTSD) and several behavioural disorders. Chances of miscarriage, intra uterine growth retardation (IUGR), preterm birth, postpartum haemorrhage increases significantly in pregnant mothers. On the other hand, maternal stress and post disaster trauma during pregnancy affects childhood body composition, metabolism and different stages of neurodevelopment.

Keywords: Natural disaster, Maternal health, Child health, Fetal health, Reproductive health

INTRODUCTION

Disasters are a recurring fact of life, and major incidents can have both immediate and long-lasting negative effects on the health and well-being of people, communities, and economies. Disasters and their destructive

effects continue to have huge and perhaps increasing impacts on human populations today. Natural disasters impart crucial threats to the health, personal security and livelihood of individuals, communities and societies (Cerna-Turoff et al., 2019; Perrow, 2011). The impacts of climate-related disaster are most harshly experienced by people living in low and middle-income countries who have a higher dependence on natural resources and who are exposed to higher rates of socioeconomic disadvantage.

A stressor can be defined as any endogenous or exogenous factor, termed 'aggressor', which affects the homeostatic systems. It could be of any type ranging from physical to psychological in nature. Pregnancy is a life event that involves biological and psychological changes, which are potentially stressful to the female. Prenatal maternal stress (PMNS) is exposure of an expectant mother to distress caused by stressful life events or by environmental hardships. This cause ill health effects both to the mother and fetus. In the last decade, women's reproductive health has become an area of interest throughout the world, particularly the United Nations, the World Health Organization, and the World Commission on Women (UN report, WHO report). The International Conference on Population Development in Cairo, defined women's reproductive health as "a state of complete physical, mental, and social well-being, and not merely the absence of diseases or infirmity, in all matters relating to the reproductive system and to its functions and processes" (Pillai and Wang, 1999). Children are also affected by environmental distress as their developmental process are challenged. With nearly 1.3 billion people, India ranks among the lowest in terms of child health, including malnutrition and under-five mortality (UNICEF, 2017). Prenatal stress can affect lifelong physical growth. Anxiety, depression, and demise might be associated with one another and with other maternal characteristics that can influence child development.

Stress has an adverse impact on implantation as well as fetal growth and may lead to spontaneous abortion. Effects are brought about by alteration of immune and endocrine systems formed by the Hypothalamus-Pituitary-Adrenal (HPA) axis together with adrenergic complex. It has already been described that stress inhibits female reproductive system primarily through inhibition of GnRH, LH, ovarian estrogen and progesterone induced by ACTH and cortisol. Such endocrine dysregulation due to any kind of stress may be the cause of miscarriage by reduction in production of ovarian progesterone, ultimately leading to failure in maintenance of pregnancy (Kang and Fox, 2000).

Role of Progesterone in Pregnancy Maintenance

Progesterone, the steroid produced by the ovary is considered as an essential hormone for reproductive success in humans due to its regulatory effects on ovulation, fertilization and implantation. During early pregnancy, this hormone co-ordinates a few complex events that synchronize embryonic development and molecular differentiation of endometrial cells for implantation. Low level or sub-optimal immuno-physiological action of progesterone at this stage can lead to miscarriage. Progesterone induces pro-implantation molecules in the endometrium through production of PIBF (progesterone induced blocking factor) in the T and B lymphocyte. PIBF leads to decreased NK cell activity and favours production of TH2 cytokines. The balance between TH1 and TH2 cytokine is reported to be crucial for successful pregnancy. IL-4, IL-10 and TGF beta2 (TH2 cytokines) produce local pro-inflammatory milieu in the deciduas for optimal trophoblastic invasion. Exposure to stress in any form of restraint induces abortion via a significant reduction in progesterone levels accompanied by reduced serum levels of PIBF and diminished expression of progesterone receptors at the feto-maternal interface (Alexandra et al., 2016). Stress has also been shown to alter cytokine production by peripheral lymphocytes during the first trimester of pregnancy (Pandian, 2009).

Stress and Immunomodulation

Immune system in pregnancy changes from inflammatory to anti-inflammatory responses. Successful pregnancy depends on positive immune-logical response together with the subsequent helpful modulation of the maternal immune system. Various substances claimed to have immunosuppressive or immunomodulating effect including alpha fetoprotein, placental proteins, early pregnancy factor (EPF), human chorionic gonadotropin (HCG), corticosteroids, estrogens, androgens and progesterone. In the first trimester immunomodulation by progesterone prevents fetal rejection and progesterone-induced blocking factor (PIBF) induces Th 2 –dominant cytokine response which favours pregnancy. Progesterone regulates HLA-G expression and NK cell activity which promote normal gestation. High levels

of stress throughout the pregnancy are linked to increased pro-inflammatory and decreased amount of anti-inflammatory cytokines making pregnant women susceptible for pre-eclampsia and pre-term birth (Druckmann and Druckmann, 2005). Women experiencing high levels of stress during pregnancy are related to increased levels of pro-inflammatory cytokines which have been associated with the occurrence of pre-eclampsia and premature labor. Increased serum levels of cytokines, C-reactive protein (CRP) due to stress during pregnancy are linked to development of pre-eclampsia, gestational diabetes and premature rupture of membranes (Kang and Fox, 2000).

Effects of Stress on Pregnant Mothers

Maternal perception of stress can activate the HPA system, which is implicated in the onset of labor. Corticotropin releasing hormone (CRH) is a neuro-peptide released by the pituitary in response to stress that sets in motion a cascade of other neuroendocrine effects, preparing the body to manage acute stress. When elevated chronically, it indicates dysregulation of the stress system, which can affect the fetus adversely. CRH is also expressed in the placenta and is thought to play a central role in both fetal maturation and onset of labor. Maternal CRH of placental origin increases exponentially over the course of normal pregnancy but it is elevated earlier and increases faster in pregnancies that end in preterm labor. Stress can alter neuroendocrine modulation of immune function leading to increased susceptibility to inflammation and infection. Various forms of infection including genital infections, intra-uterine infection, systematic maternal infections due to stress increases the risk of pre-term birth. Other serious adverse effects in maternal system including intra uterine growth retardation (IUGR), pre-eclamsia, development of gestational diabetes are through the mediators such as CRH, ACTH, cortisol and catecholamines (Arck et al., 2001). Prenatal stress also may increase high risk behaviour such as smoking, alcohol consumption or use of illicit drugs which are in turn related to pre-mature birth, low birth weight and other pregnancy complications. Alcohol intake and usage of illicit drugs also increases the risk of birth defects (Pandian, 2009).

Short term and Long term Effects of Maternal Stress on Children

The first 1000 days of human life, the time spanning roughly between conception and one's second birthday, is a distinctive period of opportunity when the foundations of optimal health, growth and neurodevelopment across the lifespan are established. Concomitant influence of nutrition, environmental hazards contribute to the loss of neuro-developmental potential. Prenatal stress is known to epigenetically program offspring physiology and behaviour and may become a risk factor for adult complex diseases, children's emotional wellbeing and memory processing. Activation of the sympathetic nervous system which occurs during stress in mothers reduces blood flow to the fetus by increasing uterine artery resistance. Cortisol from mother appears to cross the placenta and thus may affect the fetus and disturb the ongoing developmental process and fetal programming (Bergh et al., 2005). Learning problems, language deficit, cognitive development as well as difficulty in paying attention and susceptibility to increased anxiety and fearfulness may be due to maternal stress during pregnancy. The exact mechanism as to how maternal stress may cause these problems is still unclear, though several hypothesis exists.

In children, the development of the HPA axis, limbic system and the prefrontal cortex are likely to be affected by antenatal maternal stress and anxiety. There are studies showing prevalence of childhood behavioural problems related to attention-deficit hyperactivity disorder (ADHD) as a function of pre natal stress. Investigations from the prospective population based Avon Longitudinal Study of Parents and Children (ALSPAC) with two assessments during pregnancy found that anxiety in late pregnancy predicted hyperactivity and inattention syndromes in 4 year old boys and at a later follow up 8 year old boys and girls as well (Fraser et al., 2013). Stress is independently associated with later symptoms of ADHD in human children, particularly in boys. Maternal stress and maternal depression also affects childhood body composition, sensitivity and resistance of insulin hormone and subsequently leads to childhood obesity (Reeves et al., 2008).

Natural Disaster and Maternal and Child Health

Natural disasters are natural events such as flood, earthquake, hurricane that cause great damage or loss of life. Negative impacts include injury, homelessness, damage of public health system, water and sanitary infrastructure. Humanitarian emergencies resulting from natural disasters have important health

complications, including reproductive health issues (Pyone et al., 2015). Women are specifically vulnerable to disaster related health outcomes compared with men especially in low income and middle income countries. Women become vulnerable to injury and at risk of death during disasters. Research indicates that disaster may impact women's reproductive health and they are at a higher risk for abuse, mood disorders such as depression and anxiety, childbirth related complications such as bleeding, stillbirth, perianal rashes, urinary tract infections and low birth weight infant (Liu et al.,2010; Zotti et al., 2013). Three of the eight Millennium Development Goals are directly related to reproductive and sexual health while mental disorders make up three of the ten leading causes of disease burden in low and middle-income countries (Anwar et al., 2011). Earlier it was reported that the relationship between women's post-earthquake mental health and reproductive health, socio-economic status, and health care access is complex and explained largely by the socio-cultural role of women (Anwar et al., 2011). Domestic and sexual violence may increase as the aftermath of environmental disasters. In disasters, women suffer from sexual harassment and violence and experience numerous difficulties, such as nutritional and hygienic complications during pregnancy and breast-feeding. The mental health is also affected as reflected by increased emotional distress and phobic anxiety and post-traumatic stress disorder (PTSD). During disasters women faced challenges related to menstrual regulation and post-abortion care at facility and community levels. To reduce maternal mortality and morbidity from miscarriages, unsafe abortions and post-abortion complications it is important to understand all these challenges and the care-seeking patterns of pregnant women during a disaster. Restrictions on women's movement or access to public places prevent them evacuating fast from the affected area during a disaster (Juran and Trivedi, 2015). The violence and pressure toward women that already occur in male-dominant societies increase even more during disasters, leading to psychological stress and increased risks to women during disasters. Also women stay back to care for those who cannot evacuate during the disaster (Juran and Trivedi, 2015).

Pregnant women are particularly vulnerable because of their limited or no access to prenatal and obstetric care during disaster. The stress they face during delivery is huge as they do not get no skilled birth attendants, ambulances, birthing or breastfeeding stations and postnatal care in relief camps (Maheen and Itoban, 2017). In addition to their immediate effects on health and mortality, natural disaster can have indirect, long-term population health effects. Women experience the greatest stress due to their multiple responsibilities and disasters make them vulnerable to many diseases. Metabolic and hormonal changes that occur in female body due to stress causes IUGR, pre-term birth, pre-eclamsia .

Natural disaster as an independent stressor have impact on cognitive, behavioral, motor and physical development of children who were exposed to in-utero stress. Exposure to natural disaster in the past year increased the likelihood of stunting and underweight among children. The fight or flight response of children (measured by galvanic skin response or electrodermal activity) of mothers who experienced superstorm Sandy during their pregnancy were shown significantly poor. Negative impact of prenatal maternal stress (PNMS) on infant temperament appeared to be magnified when pregnant women experienced superstorm Sandy (Nomura et al., 2019). A study in 2010 revealed that most disasters had adverse and often sizeable effects on children's long-term health under 5 years. Exposure to a disaster in the past year reduces height for age and weight, increases the likelihood of stunting and underweight and reduces the likelihood of having full age appropriate immunization coverage (Datar et al., 2013).

In a cohort study in Chile scientists observed that exposure to earthquakes increased the incidence of diabetes among the affected population. Impact of diabetes was relatively higher among women of lower socioeconomic status. Also the mothers with diabetes are more likely to have large for gestational age babies (Alvarez-Aranda et al., 2019). In the Queensland flood study mothers who were exposed to flood gave birth to babies with poorer fine motor movement.(Moss et al., 2017).

CONCLUSION

Improving the well being of mothers, infants and children is an important public health goal for developing countries. The reproductive and mental health of women contributes significantly to their

overall well-being. Environmental and social factors such as access to health care, education, socioeconomic status, availability to resources and environmental hazards influence maternal and infant health condition and outcomes. The well being of mother and child determines the health of the next generation and can help predict future public health challenges for the families and communities. As mother and children are most vulnerable to any kind of disaster so it is important not only to send relief and arrange proper rehabilitation but also build resilience in communities. Making policies and arranging different social outreach programs by NGOs could help to manage the problem. A comprehensive search to identify women's physical and psychological health vulnerabilities in natural disaster across world is extremely necessary as most studies indicate that women have a higher risk to the impact of natural disasters. Destruction of property, loss of financial resources, security and shelter can lead to population migration which leads to loss of women safety and sexual harassment. A social empowerment approach may provide a broad line of action within which they may acquire resources and procedural means within which they can enhance their own lives.

Conflict of Interest

The author declares that there is no conflict of interest.

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