

**Original research article**

## **A literature review on the role of exercise and diet on foetal development**

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**Abstract**

**Background:** There are several reasons for spontaneous miscarriage including genetic, anatomical, physiological, biochemical and immunopathological milieu of the body. The consequences of the same also has several other risks including those on the health status of the expecting parents and their quality of life. The prevalence of spontaneous miscarriage is quite high in India and needs a thorough evidence on confounding factors that can help to reduce it. The aim if this review is to establish literature on the impact of exercise and diet on the foetal development.

**Data Source and Search Strategy:** Literature was searched for on the electronic database of PUBMED/MEDLINE, Wiley online Library, Scopus and related articles using the keys words or their threads in different combinations including Un-complicated pregnancy, Foetus, Embryo, Exercise, Diet, Nutrition, Lifestyle, Health (MeSH and free text search). Cross referencing was also used to establish better consensus amongst reviewers in case of confusion. This was an attempt for better conceptualisation and framing of exercises, diet and other lifestyle related components, for the expecting parents in the academic/clinical setups of the present reviewers in India.

**Discussion and Conclusion:** This review provides further evidence to and justifies the facts on the basis of which the effect of lifestyle related factors like Diet and Exercise are since yeas being propounded for healthier pregnancy and growth of foetus since decades and have also been found to be safe for administration. However, one should never oblivate that there are several possible reasons for affecting the safety of the foetus during this period including genetic, anatomical, physiological, biochemical and immunopathological milieu of the body.

**Keywords:** Un-complicated pregnancy, foetus, embryo, exercise, diet, nutrition, lifestyle, health

**Introduction**

Termination of pregnancy before the foetus can reach the 20<sup>th</sup> week of gestation i.e. during the early stages of Embryological development, due to any reason other than an intentional procedure may be termed as miscarriage. There could be many possible reasons for the same including genetic, anatomical, physiological, biochemical and immunopathological milieu of the body. The most devastating consequence is the effect on the psychological strength of the expecting parents as they are made aware that the risk of miscarriage increases every time this recurs. A study done on women of age 18-45 years pan -India demonstrated an approximately 7.46% of subjects having subsequent 3<sup>rd</sup> miscarriage risk especially in the age group above 33 years in Indian Women. Spontaneous miscarriages had higher rates than recurrent ones <sup>[1]</sup>. There was association found with age and other factors including uterine anatomy, blood, endocrine and genetic disorders, however other confounding factors including lifestyle also needs to be assessed. The aim if this review is to establish literature on the role of exercise and diet on the foetal development.

**Data Source and Search Strategy:** Literature was searched for on the electronic database of PUBMED/MEDLINE, Wiley online Library, Scopus and related articles using the keys words or their threads in different combinations including Un-complicated pregnancy, Foetus, Embryo, Exercise, Diet, Nutrition, Lifestyle, Health (MeSH and free text search) with BOOLEAN operator AND. The literature from peer reviewed journals from 1990 onwards till 2018, consisting of observational studies, RCTs, systematic reviews and meta-analysis and guidelines, full text articles in English and only those which specifically included diet/nutrition component and exercise, in an uncomplicated pregnancy, with respect to its effect

on the foetus, is represented by the reviewers in the present publication. The articles which included any other complications, disorders or any disease conditions or use of any supplements during the pregnancy were not considered. Cross referencing was also used to establish better consensus amongst reviewers in case of confusion. RHR, KMA helped in conceptualisation and all authors did the cross-reference reading for coming to a consensus. RHR and JK wrote the manuscript. This was an attempt for better conceptualisation and framing of exercises, diet and other lifestyle related components, for the expecting parents in the academic/clinical setups of the present reviewers in India.

#### **Diet and its impact on foetal development**

A study done on mice in the year 2017 demonstrated that maternal consumption of high fat diet affected the overall health and endurance capacity of the offspring possibly due to effect on their electron transport chain. Also, the young ones do not respond equally to training effect and have attenuated beneficial effects of exercises including impaired insulin sensitivity, than their counterpart whose mother has been fed low fat diet <sup>[2]</sup>. Consumption of high-methyl during pregnancy has been shown to reduce the incidence of mammary carcinogenesis in female rat offspring <sup>[3]</sup>.

Substrate with high and low glycaemic index may have different effects on the growth of the human foetus with former being better than the later. Moreover, an interaction between the type of carbohydrate substrate and exercises during different phases of pregnancy may also influence the oxygen uptake and growth of the foetus <sup>[4]</sup>.

Over a period of time, evidence also has emphasized on, not only increase in energy intake but also on resolving the nutritional gap experienced due to high metabolic state of a human body during pregnancy. There are several indices which help to identify the energy intake but fail to analyse the nutritional status of the diet as required due to increased demand. The data suggested by authors of the study done in 2015 and 2016, have clearly justified how one cannot underestimate the requirement of iodine, Vitamin A, Vit B, Calcium, iron, omega-3 fatty acids (LCn-3PUFAs), along with energy from fat and carbohydrate metabolism along with folate requirements to keep the risk of miscarriage, preterm birth or a defect in the offspring at bay. Thus, they have rightly suggested that the recommended dietary guidelines should include the nutrition component in a customised and versatile manner rather than just advising increase in energy intake, to bridge the gap <sup>[5, 6]</sup>. Many other confounding factors related to psychological state and behaviour, habits or socio-cultural environment of an individual with respect to alcohol intake or smoking, body composition, parent intelligence level, use of supplements in the child bearing age, race or ethnicity can affect the health of the foetus <sup>[5]</sup>. To sum up there are several co existing factors related to diet and nutrition and there is a plethora of outcomes pre, during and post pregnancy and their effects on the early embryological development, foetal development, neonatal development that may affect and the said effects may persist till later in life of the offspring.

#### **Exercise and its impact on Foetal Development**

In 1990 and 1991 Clapp J.F. (Clapp F, 1990; Clapp F 3rd, 1991) studied and established the instances or conditions during the pregnancy and embryological development, at which one should evaluate the effect of exercise. He has also pioneered several theories related to fetoplacental growth and the different types of exercise and their effect on preterm birth <sup>[9]</sup>, gestational age <sup>[10]</sup> and cardiovascular health <sup>[11]</sup>. Other than this the availability of oxygen and substrate at the foetus and placental junction is an important regulator of the growth of foetus. Prolonged exercise can lead to attenuation of blood flow in the placental bed <sup>[4]</sup>, however that too might have several variables to its effect including the frequency, time duration, type and the intensity of exercise along with the position in which exercise is carried out. Other than this Clapp JF 3<sup>rd</sup> equally contributed in the work on the influence of maternal exercise on the foetal autonomic system where he has been able to establish evidence on the effect of maternal exercise on the Cardiac Autonomic Nervous system parameters <sup>[12]</sup>. This was followed by a study for determination of the effect of low-moderate intensity strength training protocol for 12 weeks for the trunk and lower limb for pregnant women. The results of the study also found these exercises to be safe for administration. (O'Connor *et al.*, 2011). Several studies on mice and rodents during the period of 2013-2015 propagated the idea that perinatal exercises had both short and long term benefits on the metabolic milieu of the offspring irrespective of the general fitness level of the mother in a case of uncomplicated pregnancy <sup>[3]</sup>. In the year 2014 Evenson and his colleagues did a review on the different guidelines for physical activity prevailing around the world <sup>[14]</sup>. Health and Behavioural benefits of exercises for an uncomplicated pregnancy, were already been propounded till then by several authors. Moreover, it was also found that the physiological effects of exercise were accentuated during the pregnancy period for an individual and would become all the more intense as the term progresses. Thus, seeking medical clearance and elaborate screening before engaging in any type of exercise was considered to be vital by expert consensus. Guidelines have also enlisted a comprehensive list of Absolute and relative contraindications to exercise to avoid adverse events. Most guidelines recommended moderate to vigorous activity to be reviewed on the basis of Heart rate or on basis of rate of exertion and included both strength and aerobic exercises to be executed with great caution. The recommended frequency was to start with a customised exercise load

of 45 min per week in 3 to 4 sessions interspersed on alternate days and to progress to 120 min per week. The intensity could be ranging from 60-70% of MHR to start with and later to progress to 90% of MHR or at an RPE of 11-12 to start with and progress to that at 13-14 (somewhat hard). Signs and Symptoms of exertion immediately indicated termination of exercise. Unless there is a high-risk pregnancy none of the guidelines advocated sedentary lifestyle or bed rest and also proposed to start exercise afresh even if one has not done it in the past but with caution and after seeking medical advice and under supervision of a trained expert <sup>[14]</sup>.

### Discussion and Conclusion

The administration of dietary interventions does have a positive role during pregnancy and in the stages of foetal development. The heterogeneity in the diet with little change in the geographical topography makes it a complex subject to be analysed with precision. However, there is definitely a need to increase the nutritive quality rather than the energy component of the prescribed diet. Whether this will have an impact in the presence of some pre-existing ailment in a pregnant mother, is also a matter of concern and needs statistical inference and database for determining maternal and child health. The physiological changes with pregnancy in the different systems of the body including the blood, endocrine, musculoskeletal and the cardiovascular system have an essential role to execute during this period. These are termed as physiological adaptations with pregnancy and these can be further modulated for upregulation of the different systems of the body and thus accentuated fetoplacental growth by administration of prescribed physical activity and quality diet during pregnancy. Moreover, these two components of the lifestyle are the easiest to modify by effective behavioural counselling.

This review provides further evidence to and justifies the facts on the basis of which the effect of lifestyle related factors like Diet and Exercise are being propounded for healthier pregnancy and growth of foetus since decades and have also been found to be safe for administration. However, one should never obliterate that there are several possible reasons for affecting the safety of the foetus during this period including genetic, anatomical, physiological, biochemical and immunopathological milieu of the body.

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