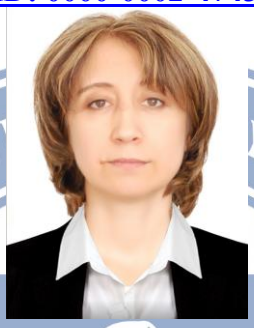
TOSHKENT TIBBIYOT AKADEMIYASI URGANCH FILIALI
JANUBIY OROLBO‘YI TIBBIYOT JURNALI
2 - TOM, MAXSUS SON-2. 2026
14.00.00 - TIBBIYOT FANLARI ISSN: 3093-8740

UDK: 12(eng)-223

EFFECTS OF MATERNAL COVID-19 INFECTION ON VERTEBRAL COLUMN GROWTH AND ANTHROPOMETRIC INDICATORS IN YOUNG CHILDREN

Tuychieva Fatima Gulamjonovna
Senior Lecturer
Tashkent State Medical University
specialty code: 14.00.02 – Morphology
E-mail: tuychievafatima@gmail.com
ORCID: 0000-0002-4743-2227



Abstract

Maternal COVID-19 infection during pregnancy may influence fetal growth and postnatal physical development through inflammatory, vascular, and hypoxic mechanisms. The vertebral column is particularly sensitive to prenatal environmental factors because spinal growth and ossification actively continue during fetal and early childhood periods. The aim of this study was to evaluate vertebral column growth and anthropometric indicators in young children born to mothers who had COVID-19 during pregnancy. Comparative analysis was performed between children prenatally exposed to maternal COVID-19 and children born to healthy mothers. The results revealed moderate alterations in spinal anthropometric parameters, posture indicators, and vertebral growth characteristics among exposed children. These findings suggest that prenatal exposure to maternal COVID-19 may affect musculoskeletal development and emphasize the importance of long-term pediatric monitoring and preventive rehabilitation strategies.

Keywords: COVID-19, maternal infection, vertebral column, spinal growth, anthropometry, children, prenatal exposure, musculoskeletal development.

Annotatsiya

Homiladorlik davrida onada COVID-19 infeksiyasining kuzatilishi yallig‘lanish, qon-tomir va gipoksik mexanizmlar orqali homila o‘sishi hamda tug‘ilgandan keyingi jismoniy rivojlanishga ta’sir ko‘rsatishi mumkin. Umurtqa pog‘onasi prenatal omillarga ayniqsa sezgir hisoblanadi, chunki umurtqa o‘sishi va suyaklanish jarayonlari homila va erta bolalik davrida faol davom etadi. Ushbu tadqiqotning maqsadi homiladorlik vaqtida COVID-19 bilan kasallangan onalardan tug‘ilgan yosh bolalarda umurtqa pog‘onasi o‘sishi va antropometrik ko‘rsatkichlarni baholashdan iborat edi. Tadqiqot davomida prenatal davrda maternal COVID-19 ta’siriga uchragan bolalar va sog‘lom onalardan tug‘ilgan bolalar o‘rtasida qiyosiy tahlil o‘tkazildi. Natijalarda asosiy guruhdagi bolalarda umurtqa antropometrik ko‘rsatkichlari, qomat holati va vertebral o‘sish xususiyatlarida ayrim o‘zgarishlar aniqlangan. Ushbu ma’lumotlar homiladorlik davridagi maternal COVID-19 infeksiyasi bolalarda tayanch-harakat tizimi rivojlanishiga ta’sir qilishi mumkinligini ko‘rsatadi hamda uzoq muddatli pediatrik kuzatuv va profilaktik reabilitatsiya muhimligini ta’kidlaydi.

Kalit so‘zlar: COVID-19, maternal infeksiya, umurtqa pog‘onasi, umurtqa o‘sishi, antropometriya, bolalar, prenatal ta’sir, tayanch-harakat tizimi rivojlanishi.

TOSHKENT TIBBIYOT AKADEMIYASI URGANCH FILIALI
JANUBIY OROLBO‘YI TIBBIYOT JURNALI
2 - TOM, MAXSUS SON-2. 2026
14.00.00 - TIBBIYOT FANLARI ISSN: 3093-8740

Аннотация

Инфекция COVID-19 у матери во время беременности может оказывать влияние на внутриутробный рост плода и постнатальное физическое развитие ребенка посредством воспалительных, сосудистых и гипоксических механизмов. Позвоночный столб особенно чувствителен к пренатальным факторам, поскольку процессы роста и окостенения позвоночника активно продолжаются в период внутриутробного и раннего детского развития. Целью данного исследования было изучение роста позвоночника и антропометрических показателей у детей раннего возраста, рожденных от матерей, перенесших COVID-19 во время беременности. Был проведен сравнительный анализ между детьми, подвергшимися пренатальному воздействию материнской COVID-19 инфекции, и детьми, рожденными от здоровых матерей. Результаты показали наличие умеренных изменений антропометрических параметров позвоночника, показателей осанки и особенностей роста позвонков у детей основной группы. Полученные данные свидетельствуют о возможном влиянии пренатального воздействия COVID-19 на развитие опорно-двигательной системы и подчеркивают необходимость длительного педиатрического наблюдения и профилактической реабилитации.

Ключевые слова: COVID-19, материнская инфекция, позвоночник, рост позвоночника, антропометрия, дети, пренатальное воздействие, развитие опорно-двигательной системы.

Introduction

The global spread of coronavirus disease 2019 (COVID-19) has created new challenges for healthcare systems and scientific research worldwide. Although COVID-19 initially attracted attention as a respiratory disease, numerous studies have demonstrated its multisystemic effects involving cardiovascular, neurological, immunological, and musculoskeletal systems [1]. Pregnant women represent a particularly vulnerable population because maternal infection may influence both maternal health and fetal development [2].

Physiological changes during pregnancy, including altered immune responses, increased oxygen demand, and cardiovascular adaptation, may contribute to more severe disease progression in infected women [3]. Maternal COVID-19 has been associated with placental dysfunction, vascular disturbances, inflammatory activation, and impaired fetal oxygenation [4]. These pathological processes may negatively affect fetal organogenesis and skeletal maturation.

The vertebral column is one of the central structural components of the musculoskeletal system. It develops through a complex sequence of embryological and postnatal growth processes involving cartilage formation, ossification, connective tissue remodeling, and neuromuscular coordination [5]. Normal spinal development depends on balanced metabolic activity, adequate oxygen supply, hormonal regulation, and healthy maternal-fetal interaction during pregnancy [6].

Several investigators have suggested that intrauterine exposure to inflammation and hypoxia may disrupt fetal bone formation and connective tissue development [7]. Cytokine imbalance and oxidative stress associated with maternal viral infections may interfere with osteogenesis and vertebral growth [8]. Furthermore, placental insufficiency may reduce fetal nutrient delivery, contributing to delayed musculoskeletal maturation [9].

Recent studies have reported developmental abnormalities and growth disturbances in children born to mothers with severe viral infections [10]. However, information regarding spinal anthropometric development in children exposed to maternal COVID-19 remains limited. Most current studies focus on respiratory and neurological outcomes, while musculoskeletal development has received comparatively little attention [11].

Anthropometric evaluation of the spine and body proportions provides valuable information regarding child growth and physical development. Measurements of spinal length, chest circumference, posture symmetry, and physiological curvatures allow early identification of developmental abnormalities and orthopedic risk factors [12].

Understanding the possible effects of maternal COVID-19 on vertebral growth is important for pediatricians, orthopedists, and rehabilitation specialists. Early diagnosis of developmental alterations may improve preventive care and reduce future musculoskeletal complications.

The purpose of this study was to investigate vertebral column growth and anthropometric indicators in young children prenatally exposed to maternal COVID-19 infection and to compare these findings with healthy controls.

Materials and Methods

The study included young children aged from infancy to early childhood. Participants were divided into two groups. The main group consisted of children born to mothers with laboratory-confirmed COVID-19 during pregnancy, while the control group included children born to mothers without COVID-19 history.

Clinical and anthropometric examination included evaluation of body height, body weight, chest circumference, spinal length, shoulder symmetry, thoracic kyphosis, lumbar lordosis, and posture characteristics. Standardized pediatric anthropometric methods and calibrated measuring instruments were used.

Maternal medical histories were analyzed, including severity of COVID-19 infection, gestational age at infection, pregnancy complications, and delivery outcomes.

Children with congenital skeletal malformations, severe neurological diseases, hereditary syndromes, or traumatic spinal injuries were excluded from the study.

Statistical analysis was performed using comparative and correlation methods. Mean values and standard deviations were calculated, and intergroup differences were analyzed using significance testing methods.

Results

The study demonstrated certain differences in vertebral column growth between the examined groups. Children prenatally exposed to maternal COVID-19 showed slightly reduced spinal length measurements compared with controls.

Alterations in posture indicators were also observed. Mild asymmetry of shoulder position and delayed formation of physiological spinal curvatures were more common among exposed children. Thoracic and lumbar curvature measurements demonstrated moderate deviations from age-related norms.

Chest circumference and thoracic mobility indicators were slightly lower in the exposed group, suggesting delayed musculoskeletal adaptation. In some cases, reduced flexibility and posture instability were identified during physical examination.

The severity of morphometric changes appeared to correlate with the severity of maternal COVID-19 infection. Children born to mothers with moderate and severe disease forms demonstrated more pronounced anthropometric alterations.

Despite these findings, most children maintained overall physical development within normal physiological ranges. However, the presence of mild spinal growth deviations indicates the possible long-term influence of prenatal inflammatory and hypoxic exposure.

Discussion

The results of this study suggest that maternal COVID-19 infection during pregnancy may influence vertebral column growth and physical development in offspring. The observed anthropometric changes may be associated with chronic intrauterine hypoxia, placental dysfunction, systemic inflammation, oxidative stress, and altered fetal metabolism.

The vertebral column is highly sensitive to disturbances occurring during fetal development. Vertebral ossification, connective tissue differentiation, and spinal curvature formation require adequate oxygenation and balanced metabolic conditions. Maternal COVID-19 may interfere with these physiological processes through vascular and inflammatory mechanisms.

The findings correspond with previous studies demonstrating that maternal viral infections can affect fetal growth and skeletal maturation. Increased inflammatory cytokines during pregnancy may alter fetal connective tissue metabolism and bone formation. In addition, placental vascular damage may contribute to impaired fetal nutrient supply and delayed spinal development.

The observed posture abnormalities and mild spinal asymmetry may have clinical significance later in life. Early disturbances in musculoskeletal growth can predispose children to scoliosis, posture disorders, chronic back pain, and reduced physical performance during adolescence and adulthood.

One of the important advantages of anthropometric assessment is the possibility of identifying developmental deviations during early childhood before severe orthopedic complications develop. Early rehabilitation measures, physiotherapy, posture correction programs, and pediatric monitoring may help prevent progression of musculoskeletal abnormalities.

The study also highlights the importance of multidisciplinary follow-up for children born after maternal COVID-19. Pediatricians, neurologists, orthopedists, and rehabilitation specialists should participate in long-term developmental monitoring of this population.

Further large-scale longitudinal studies are necessary to better understand the long-term effects of prenatal COVID-19 exposure on skeletal growth, spinal biomechanics, and physical development.

Literature Review

The reviewed literature shows that maternal COVID-19 infection during pregnancy may have important effects on fetal and postnatal child development. Gupta et al. emphasized that COVID-19 is not only a respiratory disease but also a multisystem disorder that can affect vascular, inflammatory, neurological, and metabolic processes [1]. These systemic effects are especially important during pregnancy because maternal inflammation and endothelial dysfunction may influence placental circulation and fetal growth.

Wastnedge et al. analyzed the relationship between pregnancy and COVID-19 and reported that pregnant women may represent a vulnerable group due to physiological and immunological changes during gestation [2]. Their findings suggest that maternal SARS-CoV-2 infection requires careful monitoring because it may affect both pregnancy outcomes and neonatal health.

Dashraath et al. also noted that COVID-19 during pregnancy may be associated with obstetric and perinatal complications, including preterm birth, fetal distress, and impaired fetal adaptation [3]. These data support the relevance of studying children born to mothers who experienced COVID-19 during pregnancy, especially in terms of growth and musculoskeletal development.

Placental pathology plays a central role in explaining possible developmental changes in children exposed to maternal COVID-19. Shanes et al. demonstrated that placentas from infected mothers may show vascular malperfusion, inflammatory lesions, and circulatory disturbances [4]. Such changes can reduce oxygen and nutrient supply to the fetus, which is essential for normal vertebral column growth and skeletal maturation.

The anatomical basis of spinal development is described in detail by Standring, who emphasizes that the vertebral column is a complex musculoskeletal structure responsible for support, movement, and protection of the spinal cord [5]. This indicates that any disturbance in spinal formation during prenatal or early postnatal life may later affect posture and physical development.

Sadler’s embryological studies show that the vertebral column develops through precisely regulated embryonic processes, including segmentation, cartilage formation, and ossification [6]. These processes are sensitive to maternal health, oxygenation, metabolic status, and intrauterine environmental factors.

Racicot and Mor reported that viral infections during pregnancy may affect fetal development through maternal immune activation, cytokine imbalance, placental dysfunction, and inflammatory responses [7]. These mechanisms are directly relevant to COVID-19 because SARS-CoV-2 infection may activate similar pathways.

Chen et al. studied cytokine responses in COVID-19 pregnancy and noted that inflammatory cytokines may influence maternal-fetal interaction and pregnancy outcomes [8]. Increased cytokine activity may negatively affect fetal tissue development, including connective tissue and bone formation.

Vivanti et al. discussed maternal-fetal transmission of SARS-CoV-2 and showed that vertical transmission is possible, although not frequent [9]. Even without direct fetal infection, maternal inflammatory and vascular responses may influence fetal organ development.

Malhotra et al. emphasized that maternal hypoxia can significantly affect fetal growth and organ maturation [10]. Since moderate and severe COVID-19 may be accompanied by hypoxemia, this mechanism may explain possible delays or deviations in vertebral growth among children exposed to maternal infection.

Allotey et al. conducted a systematic review on clinical outcomes of COVID-19 in pregnancy and found increased risks of adverse maternal and neonatal outcomes [11]. These findings confirm the need for long-term follow-up of children born to mothers with COVID-19.

Cameron highlighted the importance of anthropometric assessment in evaluating child growth and development [12]. Anthropometric measurements of body proportions, spinal length, chest circumference, and posture indicators can help identify early deviations in physical development.

In summary, the literature demonstrates that maternal COVID-19 may influence fetal and early childhood development through placental dysfunction, inflammation, cytokine imbalance, hypoxia, and impaired nutrient supply. Anatomical and embryological sources confirm that vertebral column development is a sensitive process that can be affected by adverse prenatal conditions. Therefore, studying vertebral column growth and anthropometric indicators in young children born to mothers with COVID-19 is scientifically relevant and clinically important.

Conclusion

Maternal COVID-19 infection during pregnancy may have a measurable influence on vertebral column growth and anthropometric development in young children. The study revealed mild but noticeable alterations in spinal length, posture characteristics, and physiological curvature formation among children exposed to prenatal maternal infection.

These findings suggest that intrauterine inflammatory, vascular, and hypoxic factors associated with COVID-19 may affect fetal musculoskeletal maturation. Although most changes remained within physiological limits, early developmental deviations may increase the risk of future orthopedic and postural disorders.

Anthropometric monitoring of spinal development should be included in routine pediatric evaluation for children born to mothers with COVID-19 during pregnancy. Early diagnosis and preventive rehabilitation strategies may improve physical development outcomes and reduce long-term musculoskeletal complications.

Comprehensive clinical investigations and long-term follow-up studies are required to clarify the pathogenetic mechanisms and clinical significance of altered spinal development associated with prenatal exposure to maternal COVID-19.

References

1. Gupta A, et al. Extrapulmonary manifestations of COVID-19. *Nat Med.* 2020;26:1017–1032.
2. Wastnedge EAN, et al. Pregnancy and COVID-19. *Physiol Rev.* 2021;101:303–318.
3. Dashraath P, et al. Coronavirus disease 2019 in pregnancy. *Am J Obstet Gynecol.* 2020;222:521–531.
4. Shanes ED, et al. Placental pathology in COVID-19. *Am J Clin Pathol.* 2020;154:23–32.
5. Standring S. *Gray’s Anatomy.* Elsevier; 2016.
6. Sadler TW. *Langman’s Medical Embryology.* Wolters Kluwer; 2019.
7. Racicot K, Mor G. Viral infections during pregnancy. *J Clin Invest.* 2017;127:1591–1599.

8. Chen YH, et al. Cytokine responses in COVID-19 pregnancy. *Front Immunol.* 2021;12:734.
9. Vivanti AJ, et al. Maternal-fetal transmission of SARS-CoV-2. *Nat Commun.* 2020;11:3572.
10. Malhotra A, et al. Maternal hypoxia and fetal growth. *Pediatr Res.* 2019;85:129–136.
11. Allotey J, et al. Clinical outcomes in pregnancy and COVID-19. *BMJ.* 2020;370:m3320.
12. Cameron N. *Human Growth and Development.* Academic Press; 2012.