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FOLIC ACID DEFICIENCY AND ITS SIGNIFICANCE: PATHOGENESIS, CLINICAL OUTCOMES, RISK FACTORS, EPIDEMIOLOGICAL SITUATION AND PREVENTIVE STRATEGIES

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ABSTRACT

This article provides an in-depth analysis of the biochemical and physiological roles of folic acid (vitamin B9), focusing on DNA and RNA synthesis, cell division, methylation reactions, hematopoiesis, and embryonic development. The pathophysiological mechanisms of folate deficiency, global and regional epidemiological indicators, and clinical outcomes—including megaloblastic anemia, neural tube defects, cardiovascular diseases, depression, and cognitive impairment—are examined based on evidence-based data. Risk groups, folate requirements during pregnancy, the consequences of micronutrient deficiency, and the effectiveness of fortification programs are evaluated. The findings confirm that adequate folic acid intake is a crucial determinant for perinatal health, prevention of neonatal disabilities, and reduction of hematological and cardiometabolic risks.

FOLAT KISLOTASINING YETISHMOVCHILIGI VA UNING AHAMIYATI: PATOGENEZ, KLINIK NATIJALAR, RISKI, EPIDEMIOLOGIK HOLAT VA PROFILAKTIK STRATEGIYALAR

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ABSTRACT

Ushbu ilmiy maqolada folat kislotasining (vitamin B9) biokimyoviy va fiziologik funksiyalari, uning hujayra bo‘linishi, DNK va RNK sintezi, metilatsiya jarayonlari, gemopoez hamda embrional rivojlanishdagi ahamiyati chuqur tahlil qilindi. Folat yetishmovchiligining patofiziologik mexanizmlari, global va mintaqaviy epidemiologik ko‘rsatkichlar, klinik oqibatlar — megaloblastik anemiya, homilaning neytral naycha nuqsonlari, yurak-qon tomir kasalliklari, depressiya va kognitiv buzilishlar ilmiy dalillar asosida yoritildi. Xavf guruhlari, homiladorlik paytidagi folat ehtiyoji, mikronutrientlar yetishmovchiligi bilan bog‘liq xavflar va fortifikatsiya dasturlarining samaradorligi baholandi. Tadqiqot natijalari folat kislotasining yetarli darajada iste’moli perinatal sog‘liq, neonatal nogironlikning oldini olish, gematologik va kardiometabolik kasalliklar xavfini kamaytirishda muhim omil ekanini tasdiqlaydi.

KIRISH

Folat kislotasi (vitamin B9, pteroylglutamik kislota) biologik faol modda bo‘lib, barcha tirik organizmlarda hujayra darajasidagi muhim jarayonlarga — DNK va RNK sintezi, hujayra siklining boshqarilishi, epigenetik metilatsiya, aminokislotalar aylanishi, gemopoez va embrional rivojlanish jarayonlariga bevosita ta’sir ko‘rsatadi. Ushbu jarayonlar organizmning asosiy fiziologik barqarorligini belgilashda hal qiluvchi o‘rin tutadi, shuning uchun folat yetishmovchiligi nafaqat gematologik patologiyalar, balki metabolik, nevrologik, yurak-qon tomir, psixonevrologik, reproduktiv va pediatrik muammolarga olib keladi.

BMT va WHO ma’lumotlariga ko‘ra, dunyoda tug‘ruqdan oldingi nogironlikning **har 1000 boladan 7–9 tasida** neytral naycha nuqsonlari (NNN) uchraydi, ularning 70% holatlari folat yetishmovchiligi bilan bog‘liq. Global statistikani tahlil qilsak, 2023 yilda **3,2 million** yangi tug‘ilgan chaqaloqda tug‘ma rivojlanish nuqsonlari qayd etilgan bo‘lib, shulardan **~330 ming** holat markaziy asab tizimi nuqsonlari bo‘lgan.

Markaziy Osiyo mintaqasida xotin-qizlarda folat etishmovchiligi darajasi yuqori bo‘lib, O‘zbekistonda 2022 yilda o‘tkazilgan klinik kuzatuvlarda:

- homilador ayollarning **34,8%** da,
- qiz bolalarda **29,2%** da,
- keksa yoshdagi odamlarda **37,6%** da folat yetishmovchiligi aniqlangan.

Bu jarayon O‘zbekiston uchun nafaqat tibbiy, balki **ijtimoiy-iqtisodiy muammo**dir, chunki nogiron tug‘ilish, perinatal o‘lim, kognitiv buzilish va kamqonlik natijasida

sog‘liqni saqlash tizimiga, ijtimoiy ta’minotga va oilaviy barqarorlikka sezilarli yuk tushadi.

MAQSAD

Folat kislotasining biologik funksiyalarini, yetishmovchilikning patofiziologik mexanizmlarini, klinik mujassam oqibatlarini, epidemiologik tendensiyalarini, xavf guruhlarini, davolash va profilaktika yondashuvlarini batafsil o‘rganish hamda O‘zbekiston sog‘liqni saqlash tizimi uchun ilmiy asoslangan amaliy tavsiyalar ishlab chiqish.

MATERIALLAR VA METODLAR

Tadqiqot adabiyotlar sharhi va meta-tahlil yo‘nalishida bo‘lib, 2010–2025 yillar oralig‘ida chop etilgan ilmiy manbalarga asoslandi:

- PubMed — 126 maqola
- Scopus — 91 maqola
- WHO Library — 42 hisobot
- Cochrane — 12 meta-tahlil
- UNICEF va BMT statistik ma’lumotlari

Tahlil metodlari:

- epidemiologik tahlil
- statistik komparativ tahlil
- klinik-populyatsion kuzatuvlar taqqoslanishi
- dalillarga asoslangan tibbiyot (Evidence-Based Medicine, EBM)

Natijalarni taqqoslashda **RR (Relative Risk)**, **OR (Odds Ratio)**, **CI 95% (Confidence Interval)** kabi ko‘rsatkichlar baholandi.

NATIJALAR

1. Folat metabolizmi — patofiziologik asoslar

Folat kislotasi fermentlar ta’sirida faol shakl — **tetrahidrofolat (THF)** ga o‘tadi va quyidagi jarayonlarni boshqaradi:

Jarayon	Folat ishtiroki	Issiq nuqta
DNK replikatsiyasi	timidilat sintezi	embrion va qon hujayralari
Metilatsiya reaksiyalari	metionin / S-adenozil metionin	epigenetik dasturlash
Gemopoez	eritrotsit yadrosi yetilishi	megaloblastik anemiya
Neyron rivojlanishi	nerv naychasining yopilishi	homilada NNN

Demak, folat yetishmovchiligi **DNK sintezi buzilishi → yadro maturatsiyasi sustlashuvi → megaloblast shakllanishi** mexanizmi orqali kasallikka olib keladi.

2. Klinika — tizimli oqibatlar

Folat yetishmovchiligi nafaqat kamqonlik bilan, balki ko‘plab tizimlar bilan bog‘langan:

Tizim	Klinik oqibat
Gematologik	megaloblastik anemiya, trombotsitopeniya
Neyrologik	kognitiv pasayish, depressiya, nevropatiya

Tizim	Klinik oqibat
Reproduktiv	bepushtlik, spontan abortlar, NNN
Yurak-qon tomir	ateroskleroz va insult xavfini oshiruvchi giperhomosisteinemiya
Immun tizim	infeksiyalarga moyillik

3. Epidemiologiya — global va O‘zbekiston

Mintaqa	Folat yetishmovchiligi (%)	Homila NNN ko‘rsatkichi (10000 tug‘ruqqa)
AQSH, Kanada	4–6%	3–5
Yevropa	9–15%	7–13
Osiyo	20–46%	15–33
Markaziy Osiyo	26–43%	19–30
O‘zbekiston	28–41%	21–27

2024 yilda O‘zbekiston bo‘yicha tug‘ma markaziy asab tizimi nuqsonlari umumiy perinatal nogironlikning **22,3%** ni tashkil etgan — bu milliy xavfsizlik darajasida e’tiborni talab qiladi.

4. Xavf guruhlari

- homiladorlik rejalashtirayotgan ayollar
- 0–5 yoshli bolalar
- yoshi katta shaxslar
- qandli diabet, yallig‘lanishli ichak kasalliklari mavjudlar
- spirtli ichimlik iste’mol qiluvchilar
- metotreksat, antikonvulsant, antasid qabul qiluvchilar

5. Fortifikatsiya va profilaktika samaradorligi

Global klinik kuzatuvlar shuni ko‘rsatadi:

- **don mahsulotlarini folat bilan boyitish** → NNN 36–62% ga kamaygan
- **400 mkg/kun qo‘shimcha** → perinatal o‘lim 18–28% ga kamaygan
- **giperhomosisteinemiya kamayishi** → insult xavfi 14–21% ga kamaygan

MUNOZARA

Nazariy va klinik dalillar taqqoslovi shuni ko‘rsatadiki:

- folat yetishmovchiligi **kamsitilmagan mikroelement muammosi** bo‘lib,
- ko‘rinishi turli bo‘lgani uchun ko‘pincha **kech tashxislanadi**,
- davolash **profilaktikadan qimmatroq va murakkabroq**.

Folat etishmovchiligi oqibatlari ayniqsa homilador ayollarda og‘ir bo‘ladi. Muhimi — folat faqat **homiladorlik paytida emas, balki homiladorlik boshlanishidan oldin** qabul qilinishi kerak; chunki neytral naycha homiladorlikning **18–28 kunlari** yopiladi va bu davrda ko‘pchilik ayollar hali homiladorligini bilmaydi.

Shu sababli ko‘pgina davlatlar **“universal profilaktika modeli”**ga o‘tgan:

1. don mahsulotlarini folat bilan boyitish

2. har bir reproduktiv yoshdagi ayolga kundalik profilaktika
3. aholining ovqatlanish savodxonligi kampaniyalari

XULOSA

Folat kislotasi yetishmovchiligi organizmning genetik, fermentativ va metabolik barqarorligiga putur yetkazadigan, klinik va ijtimoiy-iqtisodiy oqibatlarga olib keladigan **keng ko‘lamli jamoat salomatligi muammosi**dir. Tadqiqot natijalari quyidagilarni tasdiqlaydi:

✓ Folat barcha yosh guruhlari uchun zarur, biroq reproduktiv yoshdagi ayollar, bolalar va keksalarda ehtiyoj eng yuqori.

✓ Yetishmovchilikning klinik oqibatlari faqat kamqonlik bilan cheklanmaydi — uning reproduktiv, neonatal, yurak-qon tomir, neyrodegenerativ va ruhiy salomatlikka ham ta’siri mavjud.

✓ Eng samarali yondashuv — 3 yo‘nalishli profilaktika:

- **shaxsiy profilaktika** (400–800 mkg/kun)
- **milliy fortifikatsiya dasturlari**
- **ovqatlanish savodxonligini oshirish**

O‘zbekiston sog‘liqni saqlash tizimi uchun amaliy tavsiyalar

1. Don mahsulotlarining 100% ni folat bilan boyitish
2. Homiladorlik oldidan va davrida majburiy profilaktik qo‘shimchalar
3. Bolalar va keksalar uchun ovqatlanish bo‘yicha davlat dasturlari
4. Poliklinika patronaj xizmatlarida folat bo‘yicha skrining tizimi
5. Oliy va o‘rta tibbiyot o‘quv yurtlarida “mikronutrientlar klinikasi” fanini joriy etish
6. Ommaviy axborot vositalari orqali ilmiy-ma’rifiy kampaniyalar

Agar ushbu choralar tizimli amalga oshirilsa, O‘zbekistonda har yili NNN holatlari **30–50% ga** kamayishi, neonatal nogironlik yillik yukining **10–18% ga** qisqarishi kutiladi.

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