

UDC: 613.2-053.5:612.39:371.7

THE IMPACT OF PROPER NUTRITION HYGIENE ON HEALTHY GROWTH AND INTELLECTUAL DEVELOPMENT IN SCHOOL-AGED CHILDREN**Nasirdinova Maftunakhon Vosikhon kizi,**

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Abstract:Background: School age (7–17 years) is a critical period for physical growth and cognitive maturation. In Uzbekistan, rapid dietary transitions and the double burden of malnutrition (undernutrition and obesity) pose significant challenges. This study aims to evaluate the correlation between adherence to nutritional hygiene rules, physical development indices, and academic performance among schoolchildren in the Andijan region. Methods: A cross-sectional analytical study involved 500 schoolchildren aged 10–14 years. Nutritional habits were assessed using a validated Food Frequency Questionnaire (FFQ) and hygiene behavior surveys. Anthropometric measurements (BMI-for-age) were taken to assess physical status. Intellectual development was measured using academic grades and the Raven's Progressive Matrices test. Results: Children with irregular meal patterns and low hygiene compliance showed a significantly higher prevalence of stunting (12.4% vs 4.2%) and anemia (28% vs 10%) compared to the compliant group ($p < 0.001$). There was a strong positive correlation ($r = 0.68$) between a balanced diet rich in micronutrients (iron, iodine) and cognitive performance scores. Conversely, excessive consumption of processed foods was linked to attention deficits and lower academic achievement. Conclusion: Adherence to nutrition hygiene principles is a fundamental determinant of both somatic health and intellectual potential. Implementing school-based nutritional education programs is essential for fostering a healthy future generation.

Keywords: School nutrition, hygiene, physical development, cognitive function, micronutrients, academic performance, public health.

MAKTAB YOSHDAGI BOLALARDA TO'G'RI OVQATLANISH GIGIYENASINING SOG'LOM O'SISH VA INTELEKTUAL RIVOJLANISHGA TA'SIRI

Annotatsiya: Kirish: Maktab yoshi (7–17 yosh) jismoniy o'sish va kognitiv yetilish uchun hal qiluvchi davr hisoblanadi. O'zbekistonda ovqatlanishdagi tezkor o'zgarishlar va to'yib ovqatlanmaslikning "ikki tomonlama yuki" (yetishmovchilik va semizlik) jiddiy muammolarni keltirib chiqarmoqda. Ushbu tadqiqot Andijon viloyatidagi maktab o'quvchilari orasida ovqatlanish gigiyenasi qoidalariga rioya qilish, jismoniy rivojlanish ko'rsatkichlari va akademik o'zlashtirish o'rtasidagi bog'liqlikni baholashga qaratilgan. Usullar: 10–14 yoshli 500 nafar maktab o'quvchisi ishtirokida ko'ndalang (cross-sectional) tahliliy tadqiqot o'tkazildi. Ovqatlanish odatlari tasdiqlangan Oziq-ovqat Chastotasi So'rovnomasi (FFQ) va gigiyenik xulq-atvor so'rovlari yordamida baholandi. Jismoniy holatni baholash uchun antropometrik o'lchovlar (yoshga nisbatan BMI) olindi. Intellektual rivojlanish akademik baholar va Ravenning Progressiv Matritsalar testi yordamida o'lchandi. Natijalar: Ovqatlanish tartibi buzilgan va gigiyenaga rioya qilmaydigan bolalarda bo'y o'sishdan orqada qolish (12,4% ga 4,2%) va anemiya (28% ga 10%) ko'rsatkichlari rioya qiluvchilar guruhiga nisbatan sezilarli darajada yuqori bo'ldi ($p < 0.001$). Mikronutrientlarga (temir, yod) boy muvozanatli ovqatlanish va kognitiv natijalar o'rtasida kuchli musbat korrelyatsiya ($r = 0,68$) aniqlandi. Aksincha, qayta ishlangan oziq-ovqatlarni haddan tashqari iste'mol qilish diqqat yetishmovchiligi va past o'zlashtirish bilan bog'liq ekanligi ma'lum bo'ldi. Xulosa: Ovqatlanish gigiyenasi tamoyillariga rioya qilish ham somatik salomatlik, ham intellektual salohiyatning asosiy determinantidir. Maktabga asoslangan ovqatlanish ta'lim dasturlarini joriy etish sog'lom kelajak avlodni tarbiyalash uchun zarurdir.

Kalit so‘zlar: Maktab ovqatlanishi, gigiyena, jismoniy rivojlanish, kognitiv funktsiya, mikronutrientlar, akademik ko‘rsatkichlar, jamoat salomatligi.

ВЛИЯНИЕ ГИГИЕНЫ ПРАВИЛЬНОГО ПИТАНИЯ НА ЗДОРОВЫЙ РОСТ И ИНТЕЛЛЕКТУАЛЬНОЕ РАЗВИТИЕ У ДЕТЕЙ ШКОЛЬНОГО ВОЗРАСТА

Аннотация: Введение: Школьный возраст (7–17 лет) является критическим периодом для физического роста и когнитивного созревания. В Узбекистане быстрые изменения в рационе питания и двойное бремя неправильного питания (недоедание и ожирение) создают серьезные проблемы. Целью данного исследования является оценка корреляции между соблюдением правил гигиены питания, показателями физического развития и академической успеваемостью среди школьников Андижанской области. Методы: Было проведено поперечное аналитическое исследование с участием 500 школьников в возрасте 10–14 лет. Пищевые привычки оценивались с помощью валидированного опросника частоты потребления пищи (FFQ) и опросов о гигиеническом поведении. Для оценки физического статуса проводились антропометрические измерения (ИМТ к возрасту). Интеллектуальное развитие измерялось с помощью академических оценок и теста прогрессивных матриц Равена. Результаты: У детей с нерегулярным режимом питания и низким соблюдением гигиены наблюдалась значительно более высокая распространенность задержки роста (12,4% против 4,2%) и анемии (28% против 10%) по сравнению с группой, соблюдающей правила ($p < 0.001$). Была выявлена сильная положительная корреляция ($r = 0,68$) между сбалансированной диетой, богатой микронутриентами (железо, йод), и когнитивными показателями. Напротив, чрезмерное потребление обработанных продуктов было связано с дефицитом внимания и более низкой успеваемостью. Заключение: Соблюдение принципов гигиены питания является фундаментальным фактором, определяющим как соматическое здоровье, так и интеллектуальный потенциал. Внедрение школьных программ по обучению правильному питанию необходимо для воспитания здорового будущего поколения.

Ключевые слова: Школьное питание, гигиена, физическое развитие, когнитивная функция, микронутриенты, академическая успеваемость, общественное здравоохранение.

INTRODUCTION

The school-age period is characterized by intense physiological growth, neurodevelopment, and the formation of lifelong behavioral habits. Nutrition serves as the primary material basis for these processes. In Uzbekistan, as in many transitional economies, the nutritional landscape is shifting. While traditional nutrient deficiencies (iron, iodine, Vitamin A) persist, there is a simultaneous rise in the consumption of energy-dense, nutrient-poor processed foods ("junk food").

"Nutrition Hygiene" encompasses not only the safety of food but also the *regimen* of eating, the *balance* of macronutrients, and the *culture* of consumption. Deviations from hygienic norms—such as skipping breakfast, irregular meal times, excessive sugar intake, and lack of dietary diversity—can disrupt metabolic homeostasis. The brain, which consumes roughly 20% of the body's basal energy despite representing only 2% of body weight, is particularly sensitive to these disruptions.

While the link between severe malnutrition and cognitive stunting is well-established, the impact of "sub-optimal" nutrition and poor dietary hygiene on the academic performance of apparently healthy schoolchildren in the Fergana Valley is less documented. This study aims to bridge this gap by analyzing how adherence to nutrition hygiene principles correlates with physical growth anthropometry and intellectual capacity in local schoolchildren.

LITERATURE REVIEW

The Gut-Brain Axis and Cognition Recent neurobiological research highlights the "Gut-Brain Axis" as a critical pathway. A diet high in refined sugars and saturated fats can induce neuroinflammation, particularly in the hippocampus, which is essential for memory and learning. Conversely, nutrients like Omega-3 fatty acids, iron, and B-vitamins act as cofactors for neurotransmitter synthesis (dopamine, serotonin). *Nyaradi et al. (2013)* demonstrated that diet quality in early childhood predicts academic performance at age 10-12.

Meal Regularity and Glycemic Control The "Glucose Hypothesis" suggests that complex cognitive tasks require a steady supply of glucose. Skipping breakfast, a common habit among adolescents, leads to hypoglycemia and impaired attention span in the morning hours. *Adolphus et al. (2016)* confirmed in a systematic review that habitual breakfast consumption is positively associated with school grades.

Physical Growth as a Biomarker Anthropometric indicators (height-for-age, BMI-for-age) are the most reliable markers of long-term nutritional status. Stunting (low height for age) is not just a physical deficit but a marker of chronic nutritional deprivation that is strongly associated with reduced IQ and economic productivity in adulthood.

Regional Context In Central Asia, micronutrient deficiencies remain a concern. Iodine deficiency is historically endemic in the Fergana Valley, directly impacting thyroid function and intellectual development. Iron deficiency anemia, prevalent in school-age children, causes fatigue and reduced concentration.

MATERIALS AND METHODS

Study Design A cross-sectional analytical study was conducted in 5 randomly selected secondary schools in the Andijan city and surrounding rural districts (2023-2024). Participants 500 schoolchildren aged 10–14 years (grades 5-8) participated. Written informed consent was obtained from parents.

Exclusion Criteria - Chronic diseases affecting absorption (celiac disease), hormonal disorders, acute infections.

Data Collection Tools. Nutritional Hygiene Assessment: A custom questionnaire evaluating: 1) Meal frequency (breakfast skipping). 2) Diversity score (intake of fruits, vegetables, dairy). 3) "Junk food" consumption index (soda, chips, fast food). 4) Sanitary habits (handwashing before meals).

Anthropometry - Height and weight measured using calibrated stadiometers and digital scales. Z-scores calculated according to WHO Growth Reference (2007).

Intellectual Assessment. Raven's Standard Progressive Matrices (SPM): A culture-independent test of fluid intelligence and non-verbal reasoning. Academic Performance: Average Grade Point Average (GPA) for the last two quarters (Math, Native Language, Science).

Statistical Analysis - Participants were categorized into "High Hygiene Adherence" (Group A) and "Low Hygiene Adherence" (Group B). Differences were analyzed using T-tests and Chi-square tests. Pearson correlation coefficients were calculated between diet scores and Raven scores.

RESULTS

Nutritional Habits Profile Only 35% of students followed optimal nutrition hygiene (3 regular meals + 2 snacks, daily breakfast). Skipping Breakfast: 42% of children reported skipping breakfast at least 3 times a week. Junk Food: 65% consumed sugary beverages daily.

Physical Development Group B (Low Adherence) showed significantly poorer physical indicators.

Table 1: Anthropometric Indicators

Indicator	Group A (High Adherence)	Group B (Low Adherence)	P-value
Normal BMI	82.0%	55.0%	<0.001

Stunting (Height < -2 SD)	4.2%	12.4%	<0.01
Overweight/Obesity	8.5%	22.0%	<0.01
Clinical Signs of Anemia	10.0%	28.0%	<0.001

Intellectual Development There was a clear gradient in cognitive performance based on nutritional status.

Table 2: Cognitive and Academic Performance

Indicator	Group A (High Adherence)	Group B (Low Adherence)	P-value
Raven's Test Score (Max 60)	48.5 ± 5.2	39.2 ± 6.1	<0.001
Average GPA (5-point scale)	4.4 ± 0.4	3.6 ± 0.5	<0.001
Attention Deficit Complaints	15%	45%	<0.001

Breakfast - Regular breakfast consumption correlated positively with Math scores ($r=0.55$).

Iodine/Iron - Children reporting daily consumption of iodized salt and red meat/greens had 15% higher scores on Raven's matrices than those with low intake.

DISCUSSION

The study results unequivocally demonstrate that nutrition hygiene is a pillar of child development. The "double burden" was evident in Group B, where both stunting (due to micronutrient deficiency) and obesity (due to caloric excess from junk food) coexisted.

Mechanism of Impact: The lower cognitive scores in Group B likely stem from transient hypoglycemia (skipping meals) affecting concentration in class, combined with chronic micronutrient deficits (iron, iodine) impairing neural plasticity. The high consumption of sugary drinks leads to "sugar crashes," causing irritability and lethargy, which teachers often misdiagnose as behavioral problems.

The Role of School Canteens: Observation revealed that many children purchase low-quality snacks at or near school. This highlights the need for regulatory control over food environments around educational institutions.

CONCLUSION

Proper nutrition hygiene is not merely a biological necessity but an educational tool. A child who is well-nourished is better equipped to learn.

Adherence to nutrition hygiene rules is strongly positively correlated with physical growth and intellectual performance.

Skipping breakfast is the single most detrimental habit affecting academic attention.

Hidden hunger (deficiency of Fe, I, Zn) remains a barrier to realizing full cognitive potential in the region.

RECOMMENDATIONS

Implement or strengthen free/subsidized healthy breakfast programs in primary schools.

Incorporate "Science of Nutrition" into the school curriculum, teaching children *why* they need to eat vegetables, not just *to* eat them.

Conduct workshops for parents on preparing affordable, nutrient-dense lunchboxes and the importance of iodized salt.

Ban the sale of carbonated sugary drinks and chips within 500 meters of school premises.

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