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Original Research Article

Physical fitness in Belarusian children with chronic gastritis

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ABSTRACT

Background: Chronic gastritis is a common pediatric condition characterized by inflammation of the gastric mucosa. Its potential impact on children's growth and physical development remains underexplored. This study aimed to assess the relationship between chronic gastritis and physical development in Belarusian children, focusing on height and body mass index (BMI) compared to WHO growth standards.
Methods: A retrospective cross-sectional review was conducted on 100 pediatric patients diagnosed with chronic gastritis in 2023 at Grodno Regional Clinical Pediatric Hospital, Belarus. Growth indicators were analyzed using AnthroPlus software, with Z scores for height-for-age and BMI-for-age calculated and compared against WHO reference values.
Results: Among the 100 children (76% female, mean age 13 years), height-for-age z-scores demonstrated a rightward shift, indicating taller stature compared to WHO standards. Conversely, BMI-for-age z-scores showed a leftward shift, reflecting lower BMI values. This disproportionate growth pattern tall stature with lean body composition was more pronounced in girls and persisted across age groups, particularly in middle and high school children.
Conclusions: Chronic gastritis in children appears to negatively influence physical development by reducing BMI, despite an unexpected trend toward increased height. These findings highlight the importance of monitoring growth trajectories and addressing nutritional and metabolic factors in pediatric patients with chronic gastritis. Further multi-center studies are needed to validate these results and clarify underlying mechanisms.

Keywords: Chronic gastritis, Belarusian children, Physical fitness, Relationship, Height-for-age, BMI-for-age

INTRODUCTION

Gastritis is a disease characterized by inflammation of the stomach's mucosal lining, which may present in either acute or chronic forms.[1] A definitive diagnosis of chronic gastritis requires histopathological evidence of abnormal gastric mucosa due to inflammation, while endoscopy and radiology serve as valuable adjunct investigations.[2]

The common etiologies of chronic gastritis include *Helicobacter pylori* infection, autoimmune responses, and reactive or chemical ingestion.[2] Studies have shown that *H. pylori* associated chronic gastritis is linked to poor weight gain and short stature because of impaired nutrient absorption. In contrast, autoimmune gastritis often leads to iron deficiency anemia and vitamin B12 deficiency, both of which contribute to growth impairment and cognitive developmental delays.[3-5]

Because chronic inflammation and metabolic imbalance interfere with nutrient absorption and energy utilization, growth impairment is a well-recognized complication of chronic illnesses in children.[6] However, compared to other chronic conditions, the specific impact of chronic gastritis on physical development remains less clearly defined. Some studies suggest that chronic gastritis predisposes children to malnutrition and reduces growth velocity.[7]

Assessment of a child's growth typically involves comparing weight, height, and length against established growth standards. While genetic predisposition plays a role, external influences such as past and present illnesses significantly shape growth trajectory. Among these, chronic gastritis may represent an important factor affecting physical development outcomes.

This study therefore aims to analyze the relationship between chronic gastritis and physical development in children by examining age wise and gender specific deviations. It further seeks to clarify whether chronic gastritis is associated with disproportionate growth and to highlight the clinical importance of monitoring both stature and body composition in pediatric gastroenterology. This study aimed to assess the correlation between physical development and chronic gastritis in Belarusian children.

METHODS

This cross-sectional study was conducted at the Grodno Regional Clinical Pediatric Hospital in Grodno, Belarus. The study took place between February 2024 and December 2025 and involved the review of clinical records of children who had been diagnosed with chronic gastritis. All included patients had received their diagnosis and treatment within the year 2023.

A total of 100 children were enrolled in the study. Eligibility was based on a confirmed diagnosis of chronic gastritis established through the identification of morphological changes in the gastric mucosa. Diagnostic confirmation followed the Sydney Classification System for chronic gastritis, ensuring standardized assessment across all cases. From each record, the medical card number, gender, date of birth, date of admission, date of discharge, birth weight, birth height, age at onset of illness, and current anthropometric measurements (height, weight) were recorded in a structured spreadsheet using Excel 2010 software. These measurements were used to calculate body mass index (BMI), height for age Z scores, and BMI for age Z scores using WHO AnthroPlus software.

Inclusion criteria

The inclusion criteria for this study were: (1) a final diagnosis of chronic gastritis confirmed by morphological evaluation according to the Sydney Classification System; (2) diagnosis and treatment occurring within the year 2023; (3) patient's and guardian's consent and (4) availability of complete clinical and anthropometric data.

Exclusion criteria

Exclusion criteria included incomplete or missing essential data, absence of consent, absence of morphological confirmation of chronic gastritis, or diagnosis outside the specified timeframe. Comorbidities were not considered in the analysis, as the study focused solely on chronic gastritis related parameters.

Statistical analysis

Analyses were performed using WHOAnthroPlus version 1.0.4. WHO AnthroPlus is software designed and developed for assessing the growth of children and adolescents in the world by the Department of Nutrition for Health and Development of WHO. This software provides indicators like weight for age, height for age, BMI for age, weight for height, head circumference for age, etc., which helps to monitor the growth of the child. This study further used AnthroPlus software to analyze the indicators height-for-age and BMI-for-age graphically to understand the relationship between chronic gastritis and physical development in children.

RESULTS

According to the z-scores obtained from the AnthroPlus software for each child height-for-age and BMI-for-age of these children were analyzed. Data (z-scores) were expressed in standard deviation (SD) units and were analyzed compared to the World Health Organization (WHO) standards.

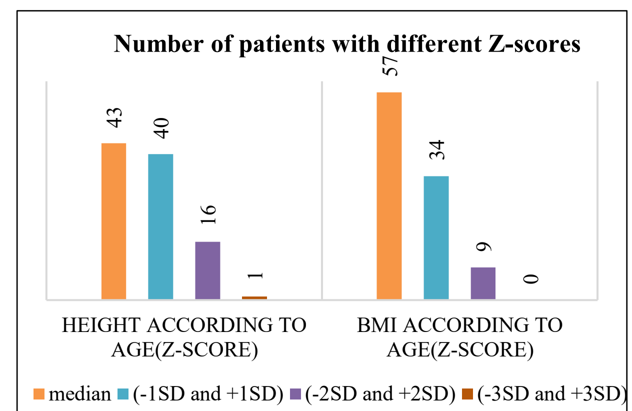

Figure 1: Bar graphs denoting number of patients with different z-scores for both height-for-age and BMI-for-age.

Based on the graphical analysis in Figure 1, among the 100 observed children, height-for-age values showed that 43% were within ±0.0-0.9 SD, 40% within ±1.0-1.9 SD, 16% within ±2.0-2.9 SD, and 1% within ±3.0-3.9 SD. Similarly, BMI-for-age results indicated that 57% were within ±0.0-0.9 SD, 34% within ±1.0-1.9 SD, and 9% within ±2.0-2.9 SD. Notably, one male patient (17 years old, weighing 106 kg and measuring 203 cm in height) exhibited an exceptionally high height-for-age z-score of 6.03 (Figure 1).

Considering the pie chart depicted in figure 2, 76% of the children in Belarus with chronic gastritis in 2023 were female, while 24% were male (Figure 2).

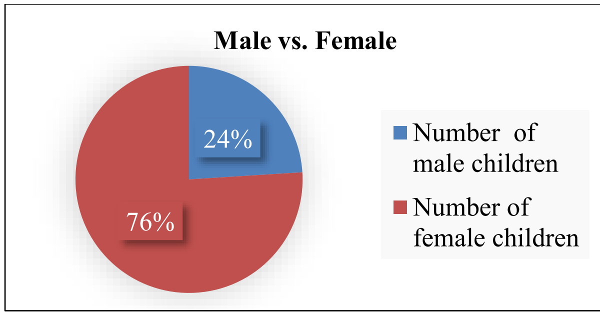

Figure 2: Pie chart denoting male to female ratio of the examined children with chronic gastritis.

In 2023, children aged 7 to 17 years were identified as having chronic gastritis. For analysis, they were classified into three school-age categories: elementary school (5-10 years), middle school (11-13 years), and high school (14-18 years). Of the total sample, 11% fell within the elementary school group, 30% within the middle school group, and 59% within the high school group. The average age of all children included in the study was approximately 13 years. Their mean weight, height, and BMI were 54.89 kg, 163.25 cm, and 20.2 kg/m², respectively (Figure 3).

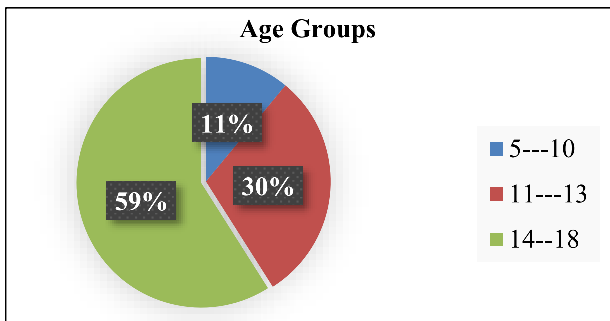

Figure 3: Pie chart depicting the percentage of children with chronic gastritis by age category.

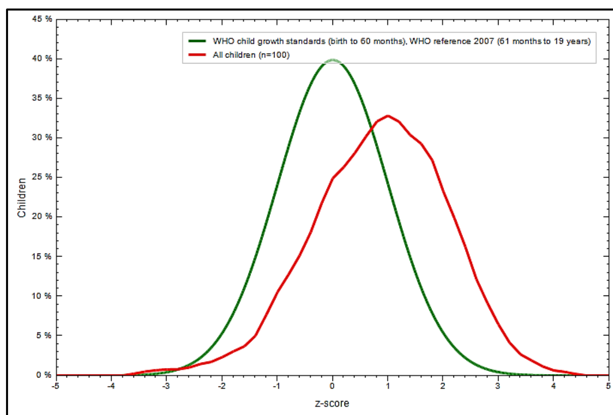

Figure 4: Height-for-age variation of children compared with WHO growth standards.

Figure 4 shows the Comparison of height-for-age distribution between WHO growth standards and study population. The green curve represents the WHO child growth standards, which are centered around a z-score of 0, reflecting the expected average height-for-age distribution in a healthy reference population. In contrast, the red curve illustrates the height-for-age distribution of the 100 children examined in this study. Notably, the red curve demonstrates a distinct rightward shift compared to the WHO standard, with its peak occurring around a positive z-score. This shift indicates that, on average, children with chronic gastritis in this cohort were taller than the WHO reference population for their age. The divergence between the two curves highlights a disproportionate growth pattern, suggesting that despite the presence of chronic gastritis, these children exhibited increased stature relative to international growth norms (Figure 4).

The graph shown in figure 5 illustrates how height-for-age z-scores among children with chronic gastritis deviate from WHO reference values across different age groups. A consistent rightward shift is observed, indicating that these children were generally taller than the WHO standard population. The deviation is most pronounced between the ages of 7 and 14 years, where mean z-scores remain consistently above +2. The peak difference occurs around 7-8 years of age, with a mean z-score reaching +3, although this finding is based on a relatively small sample size. Despite some variation, the elevated trend persists into adolescence, with mean z-scores remaining higher than WHO norms, though slightly lower than the peak observed in younger age groups. This pattern suggests that children with chronic gastritis in this cohort demonstrated a growth trajectory characterized by increased stature relative to international standards, particularly during middle childhood and early adolescence (Figure 5).

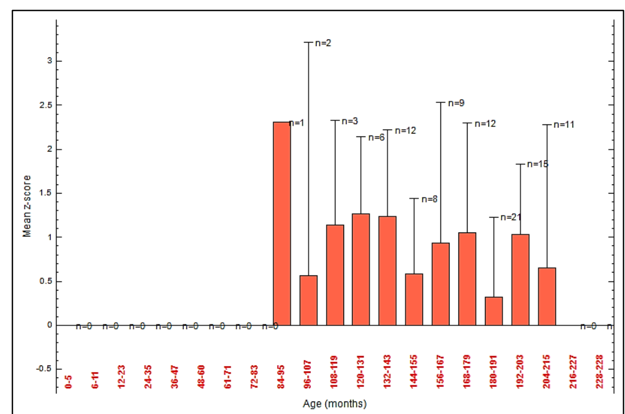

Figure 5: Age-wise deviation of height-for-age z-scores compared with WHO growth standards.

The graph generated using AnthroPlus software illustrates the gender-specific distribution of height-for-age z-scores among the 100 children included in this study, compared with WHO reference values. While the WHO curve is centered at a z-score of 0, both male and female cohorts demonstrate a clear rightward shift, indicating that children with chronic gastritis were generally taller than

expected for their age. The deviation was more pronounced among female participants, whose distribution clustered predominantly between +2 and +3 z-scores, suggesting a significant elevation in stature relative to WHO norms. Male participants also exhibited a positive deviation, though their clustering was closer to +1 to +2 z-scores, reflecting a comparatively moderate increase in height. Taken together, these findings reveal that, contrary to the anticipated growth impairment often associated with chronic illness, children with chronic gastritis in this cohort displayed increased height-for-age values, with the effect being particularly marked among girls (Figure 6).

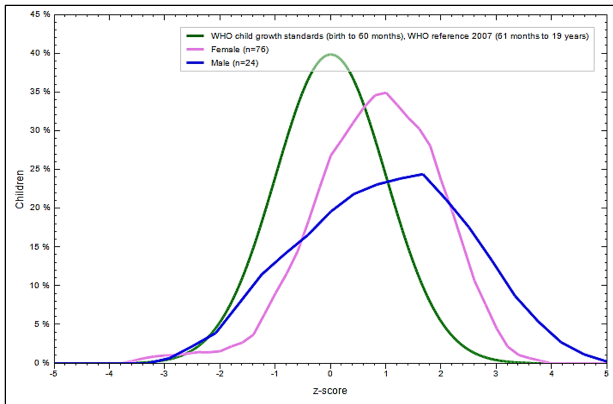

Figure 6: Gender-wise deviation of height-for-age z-scores compared with WHO growth standards.

The graph presented in figure 7 which is generated using AnthroPlus software compares BMI-for-age z-scores of the study cohort with WHO reference data. The green line represents the WHO child growth standards (birth to 60 months) and WHO reference 2007 (61 months to 19 years), which are centered around a z-score of 0, reflecting the expected distribution of BMI in healthy children. In contrast, the red line denotes the distribution of BMI-for-age z-scores for the 100 children diagnosed with chronic gastritis in this study. A clear leftward shift of the red curve relative to the green curve is observed, indicating that the study population had lower BMI-for-age values compared to the WHO reference population (Figure 7).

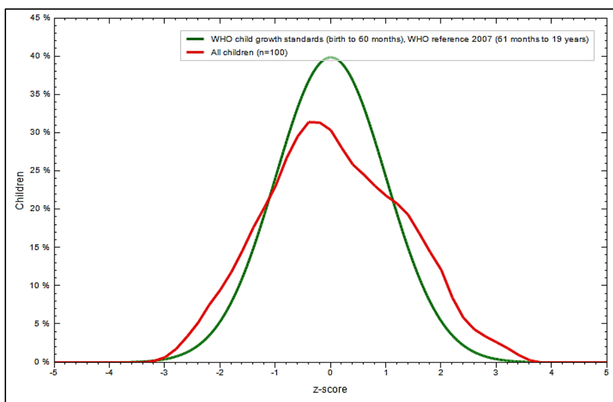

Figure 7: BMI-for-age distribution compared with WHO standards.

The graph in figure 8 illustrates the age-specific distribution of BMI-for-age z-scores among children diagnosed with chronic gastritis. In the elementary school group (5-10 years), mean BMI z-scores hovered around 0 to slightly positive values, indicating BMI levels comparable to or marginally higher than WHO reference standards. In contrast, middle school children (11-13 years) demonstrated a decline in mean BMI z-scores, ranging between -0.5 and -1.5. With sample sizes between 8 and 15, this downward trend appears reliable, suggesting that children in this age group were leaner than their WHO counterparts (Figure 8).

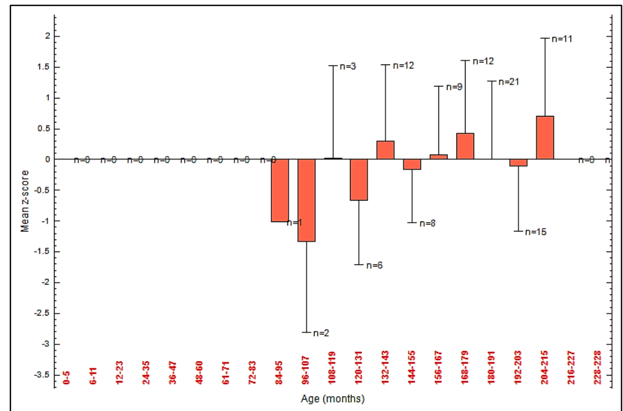

Figure 8: Age-wise distribution of BMI-for-age z-scores compared with WHO standards.

The most pronounced deviation was observed in the high school group (14-18 years), where mean BMI z-scores consistently remained negative, between -1 and -2. This finding, supported by the largest sample size (n=21), strengthens confidence in the observation that adolescents with chronic gastritis had persistently lower BMI values compared to WHO standards.

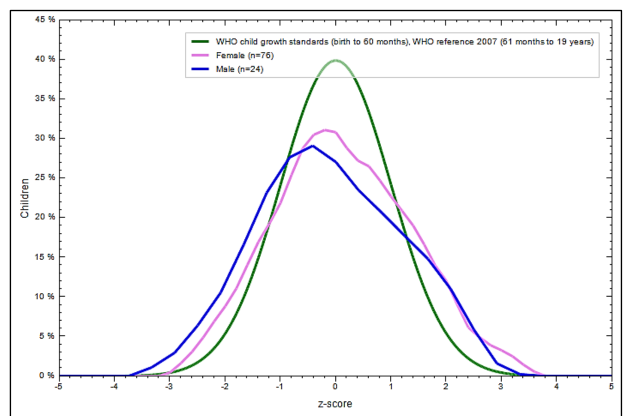

Figure 9: Gender-wise distribution of BMI-for-age z-scores compared with WHO standards.

The graph provides a gender-specific comparison of BMI-for-age z-scores among the 100 children in this study relative to WHO reference values. The green curve, representing WHO growth standards, is centered at a z-

score of 0, reflecting the expected distribution of BMI in healthy children. In contrast, both the pink curve (female participants, n=76) and the blue curve (male participants, n=24) demonstrate a leftward shift from the WHO reference, indicating that children with chronic gastritis were generally leaner than expected for their age (Figure 9).

This deviation was more pronounced among female participants, whose BMI-for-age values clustered predominantly between -1 and -2 z-scores, suggesting a significant reduction in body mass relative to WHO norms. Male participants also exhibited lower BMI values, though their distribution was closer to the WHO curve, clustering around -0.5 to -1 z-scores, reflecting a comparatively milder deviation.

DISCUSSION

In this study, the growth outcomes of 100 pediatric patients with chronic gastritis were analyzed using AnthroPlus software. The analysis revealed a disproportionate growth pattern among children with chronic gastritis.

Height-for-age: atypical upward deviation

Here height-for-age z-scores demonstrated a consistent rightward shift compared to WHO standards, indicating that these children were taller than expected for their age. The deviation was most pronounced between 7 and 14 years, where mean z-scores exceeded +2, with a peak of +3 observed in younger age groups.

This finding contrasts with the anticipated growth impairment often associated with chronic illness. Many existing studies associate chronic gastritis, particularly *Helicobacter pylori* related disease with impaired linear growth due to chronic inflammation, reduced appetite, and micronutrient malabsorption. Prior studies have demonstrated that *H. pylori* infection correlates with short stature and reduced height velocity in children.[8,9] Autoimmune gastritis, similarly, is linked to iron deficiency anemia and vitamin B12 deficiency, both of which contribute to growth impairment and neurodevelopmental delays.[10] To evaluate this finding clinically, the current study suggests several possible reasons.

If chronic gastritis developed after early childhood, when most linear growth deficits typically manifest, the height may remain unaffected. Some studies suggest that growth impairment from chronic gastritis is more pronounced when disease onset occurs before age 5.[11]

Other potential reason can be heterogeneity of gastritis etiology. This study did not stratify by etiology (*H. pylori* vs. autoimmune vs. chemical/reactive). Non–*H. pylori* gastritis may exert less influence on linear growth. Some European studies have reported normal or above-average stature in children with late-onset gastritis or mild *H. pylori* infection.[12]

Regional population characteristics may partly explain the increased stature observed in this study; populations from certain geographic areas exhibit higher average height independent of disease status.[13] Belarusian children may have population-specific height trends that differ from WHO standards. The WHO reference range is multinational and may not perfectly reflect Eastern European growth patterns. Moreover, children referred to this hospital (regional pediatric hospital) may represent a subgroup with better baseline health or higher socioeconomic status, both of which can positively influence stature.

BMI-for-age: consistent downward deviation

In contrast, BMI-for-age z-scores consistently demonstrated a leftward shift relative to WHO standards, indicating lower BMI values across age groups. Elementary school children showed BMI values close to WHO averages, but middle school and high school children exhibited progressively negative z-scores, ranging from -0.5 to -2.0. This trend was particularly pronounced in adolescents, where larger sample sizes strengthened the reliability of the findings. This aligns more closely with existing literature, which frequently reports reduced BMI, poor weight gain, and leaner body composition in children with chronic gastritis.

The mechanisms underlying the observed pattern may include impaired nutrient absorption, metabolic dysregulation, and other disease related effects that limit weight gain. Chronic gastritis, particularly in its atrophic form, disrupts gastric physiology and secretory function and can therefore contribute to micronutrient deficiencies and altered growth outcomes.[1] Infection with *Helicobacter pylori* has also been associated with impaired growth and lower weight indices in children, plausibly via reduced appetite, malabsorption, and chronic inflammation.[7,14] Furthermore, nutrient malabsorption, persistent inflammation, and iron deficiency help explain the growth faltering observed in children with chronic gastritis, particularly when *H. pylori* infection is prolonged.[15-17] This aligns with previous research indicating impaired growth parameters, including reduced weight gain and nutritional deficiencies among children diagnosed with chronic gastritis.[18]

The age-wise analysis further supports this interpretation. Adolescents (14-18 years) showed the most pronounced BMI deficits (-1 to -2 SD), suggesting that chronic gastritis may exert cumulative effects on body mass over time. This pattern is consistent with studies showing that weight is affected earlier and more severely than height in chronic gastrointestinal inflammation where adolescents show pronounced BMI deficits due to increased metabolic demands.[19]

Gender differences in growth patterns

The study revealed notable gender-specific trends. Gender-specific analysis highlighted that girls exhibited greater elevation in stature, clustering around +2 to +3 z-scores, while boys clustered closer to +1 to +2. According to BMI-for-age scores, girls had much greater decline, clustering around -1 to -2 z-scores, while boys showed milder deviations.

Earlier pubertal onset in girls, which may temporarily elevate height-for-age z-scores; greater susceptibility to weight loss due to hormonal fluctuations affecting appetite and metabolism; and higher prevalence of functional gastrointestinal symptoms in adolescent girls, as documented in multiple epidemiological studies can be considered as possible explanations.[20-22] These findings underscore the importance of gender-specific monitoring in pediatric gastroenterology.

Several limitations must be acknowledged. First, the study was conducted in a single hospital within one country with a small sample size, limiting generalizability. Second, birth-related growth parameters and early z-score changes were not considered, which may have influenced the interpretation of long-term growth trajectories. Third, comorbidities and other diseases were not accounted for, potentially confounding the observed associations. Lack of etiological stratification and absence of dietary, socioeconomic, or pubertal status data may also have limited the scope of findings of this study. Despite these limitations, the findings provide important insights into the impact of chronic gastritis on child growth.

CONCLUSION

This cross-section review was conducted in Grodno, Belarus to analyze the relationship between physical development and chronic gastritis among the children within a year. This study suggests that chronic gastritis in children, particularly from middle childhood (6-11 years) to early adolescence (12-18 years), can negatively impact physical development, leading to decreased BMI. Majority of the study subjects were female and were high school children (14-18 years). Even though these children were taller than the WHO norm, they were proved to be leaner than the WHO norm, suggesting disproportionate growth; possibly reflecting altered nutrition, metabolism, or disease related effects. These findings underscore the importance of monitoring growth and development in pediatric patients with chronic gastritis and addressing any nutritional deficiencies to support healthy growth. Nonetheless, several limitations must be acknowledged such as the study's single-center design, small sample size, absence of birth and early growth data, and unmeasured comorbidities. Despite these constraints, the study provides valuable insight into how chronic gastritis may affect child growth, revealing a pattern of increased height paired with reduced BMI.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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