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# Predictive Value of First Trimester APRI Score and FIB-4 Index for Gestational Diabetes Mellitus

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## Abstract:

**Objective:** Inflammation, liver injury, and subclinical fibrotic processes secondary to insulin resistance are thought to play an important role in gestational diabetes mellitus (GDM). This study aimed to evaluate the predictive value of the aspartate aminotransferase–platelet ratio index (APRI) and fibrosis-4 (FIB-4) index, which reflect inflammatory status and hepatic involvement, for the prediction of GDM.

**Methods:** This retrospective study included 3,305 pregnant women who delivered at Department of Obstetrics and Gynecology, Bursa Yüksek İhtisas Training and Research Hospital between January 2020 and December 2024. Of these, 371 women were diagnosed with GDM, while 2,934 women with normal glucose tolerance constituted the control group. Oral glucose tolerance test results, APRI scores, and FIB-4 indices were compared between the groups.

**Results:** The median APRI score and FIB-4 index were significantly higher in the GDM group than in the control group (P<0.001 and P=0.027, respectively). An APRI score >0.22 predicted GDM with a sensitivity of 61.46% and a specificity of 66.02% (AUC=0.667, P<0.001), whereas a first-trimester FIB-4 index >0.53 showed a sensitivity of 66.31% and a specificity of 41.0% (AUC=0.535, P=0.027). ROC analysis demonstrated that first-trimester APRI had significantly greater predictive ability for GDM than FIB-4 (P<0.001). Correlation analysis revealed no significant associations between APRI and clinical parameters, while the FIB-4 score showed weak positive correlations with age and parity.

**Conclusion:** The present study suggests that both APRI score and FIB-4 index may serve as noninvasive biomarkers for the early prediction of GDM. Notably, the APRI score demonstrated superior predictive performance compared with FIB-4 index.

**Keywords:** Gestational Diabetes Mellitus, APRI Score, FIB-4 Index, Inflammation, Oral Glucose Tolerance Test

Gestational diabetes mellitus (GDM) is a common metabolic disorder of pregnancy, defined as glucose intolerance with onset or first recognition during gestation [1]. Over recent decades, its global prevalence has increased substantially, largely driven by advancing maternal age, rising obesity rates, and increasingly sedentary lifestyles [1, 2]. Nevertheless, reported prevalence varies widely depending on diagnostic criteria and population characteristics, with GDM affecting

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approximately 5–25% of pregnancies worldwide [2].

Beyond its immediate obstetric implications, GDM is associated with adverse maternal and neonatal outcomes, including hypertensive disorders of pregnancy, cesarean delivery, fetal macrosomia, and neonatal metabolic complications [1, 3]. Importantly, GDM represents not only a transient pregnancy complication but also a marker of long-term cardiometabolic risk. Women with a history of GDM have a significantly increased likelihood of developing type 2 diabetes mellitus and cardiovascular disease later in life [4].

The pathophysiology of GDM is multifactorial and extends beyond isolated disturbances in glucose metabolism. Exaggerated insulin resistance, inadequate β-cell compensation, chronic low-grade inflammation, oxidative stress, and endothelial dysfunction play central roles in disease development [3, 5]. Several studies have shown that inflammatory and hematological biomarkers measured in early pregnancy are associated with subsequent GDM development, supporting the concept that metabolic dysregulation precedes clinical diagnosis [5, 6]. Recently, liver-related indices originally developed to assess hepatic fibrosis have attracted increasing interest in metabolic research. The aspartate aminotransferase–to–platelet ratio index (APRI) and the fibrosis-4 (FIB-4) index are calculated using routinely available laboratory parameters and reflect hepatic injury, inflammation, and fibrotic activity [7]. Insulin resistance is closely linked to non-alcoholic fatty liver disease (NAFLD), which shares overlapping metabolic and inflammatory pathways with GDM [7, 8].

Emerging evidence suggests that the APRI and FIB-4 indices may have predictive value for GDM. Several recent studies have reported higher values of these indices in women who subsequently develop GDM compared with normoglycemic controls; however, most previous studies have evaluated APRI and FIB-4 separately, and their findings have been inconsistent and sometimes conflicting across different populations [6, 9–11]. Given the growing burden of GDM and the need for simple, non-invasive, and cost-effective tools for early prediction, the present study is the first to directly compare the predictive roles of APRI and FIB-4 for GDM.

## METHODS

### Study Design and Study Population

This study was designed as a single-center retrospective cohort study and conducted at the Department of Obstetrics and Gynecology, Bursa Yüksek İhtisas Training and Research Hospital. The study protocol was approved by the Local Ethics Committee (2024-TBEK 2025/03-12) and the study was in accordance with the Declaration of Helsinki. Due to the retrospective design, informed consent was waived.

A total of 3305 singleton pregnant women who underwent routine GDM screening and delivered at our institution between January 1, 2020, and December 31, 2024, were included. Participants were divided into two groups: 1. GDM group: 371 women diagnosed with GDM, 2. Control group: 2934 women with normal glucose tolerance.

Inclusion criteria were: singleton pregnancy, delivery at ≥24 weeks of gestation, and availability of first-trimester laboratory parameters including aspartate aminotransferase, alanine aminotranferase, and platelet count. Exclusion criteria were pre-existing type 1 or type 2 diabetes mellitus, known chronic liver disease, viral hepatitis, autoimmune hepatic disorders, multiple gestations, chronic inflammatory or systemic diseases, or use of medications affecting liver function.

Screening for GDM was performed between 24 and 28 weeks of gestation using either a one-step or a two-step approach, in accordance with institutional protocols and international recommendations. The one-step method consisted of a 75-g oral glucose tolerance test (OGTT), while the two-step strategy included an initial 50-g glucose challenge test followed, if abnormal, by a diagnostic 100-g OGTT. Gestational diabetes mellitus was diagnosed based on the criteria of the American Diabetes Association (ADA) and the International Association of Diabetes and Pregnancy Study Groups (IADPSG), defined as at least one abnormal plasma glucose value on the 75-g OGTT or two or more abnormal values on the 100-g OGTT [1, 12]

All laboratory parameters were obtained from routine antenatal blood samples collected during the first trimester. Serum aspartate aminotransferase (AST), alanine aminotransferase (ALT), and platelet counts were analyzed using standardized automated methods in the hospital laboratory.

Non-invasive liver fibrosis markers were calculated using the following formulation based on first-trimester laboratory values, prior to the diagnosis of GDM in patients, and using transaminase and platelet data.

APRI score:(AST [U/L] / Upper Limit of Normal AST [U/L]) × 100 / Platelet count [10^9/L].
FIB-4 Index: (Age [years] x AST [U/L]) / (Platelet count [10^9/L] × √ALT [U/L]).

## Statistical Analysis

The normality of continuous variables was assessed using the Kolmogorov–Smirnov test. Non-normally distributed variables were expressed as median with minimum and maximum values and compared using the Mann–Whitney U test, while categorical variables were presented as numbers and percentages and analyzed using the Chi-square test. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the predictive performance of APRI and FIB-4 scores, and optimal cut-off values, sensitivity, specificity, and area under the curve (AUC) were calculated. Comparative ROC curve analysis was performed using the DeLong method to compare the AUCs of APRI and FIB-4. Correlations between variables were assessed using Spearman's rank correlation coefficient. All statistical analyses were conducted using SPSS version 22.0 (IBM Corp., Armonk, NY, USA) and MedCalc version 18, and a P-value of less than 0.05 was considered statistically significant.

## RESULTS

A total of 3305 pregnant women were included in the study. Among them, 371 women (11.2%) were diagnosed with GDM, while 2934 women (88.8%) had

**TABLE 1. Demographic and Perinatal Characteristics of GDM and Control Groups**

| | GDM (n=371) | Control (n=2934) | P-value |
|---|---|---|---|
| **Age (year)** | 30 (17-43) | 29 (17-42) | 0.990 |
| **Gravida (n)** | 3 (1-10) | 3 (1-8) | 0.105 |
| **Parity (n)** | 2 (0-5) | 2 (0-6) | 0.175 |
| **Abortions (n)** | 0 (0-5) | 0 (0-4) | 0.056 |
| **Body mass index (kg/m²)** | 30.2 (20.6-32.5) | 27.3 (19.2-30.8) | 0.060 |
| **Gestational week at OGTT (week)** | 27 (24-28) | 26 (24-28) | 0.078 |
| **Polyhydramnios, n (%)** | 108 (29.1) | 88 (2.9) | **<0.001** |
| **Macrosomia, n (%)** | 84 (22.6) | 237 (8) | **0.001** |
| **Preterm birth, n (%)** | 56 (15.1) | 343 (11.7) | 1.000 |
| **Diabetic ketoacidosis, n (%)** | 6 (1.6) | 0 (0) | 0.092 |
| **Gestational age at delivery (w)** | 39 (31-42) | 39 (30-41) | 0.465 |
| **Mode of Delivery** | | | 0.637 |
| Vaginal delivery | 225 (60.6) | 1885 (64.2) | |
| Cesarean delivery | 146 (39.4) | 1049 (35.8) | |
| **Birth weight (g)** | 3320 (1760-4600) | 3250 (1400-4530) | **0.014** |
| **Apgar score at 1 min** | 9 (5-9) | 9 (3-9) | 0.998 |
| **Apgar score at 5 min** | 10 (6-10) | 10 (4-10) | 0.654 |
| **NICU admission, n (%)** | 85 (22.9) | 526 (17.9) | 0.052 |

Data are shown as median (range) or number (percentage). GDM, gestational diabetes mellitus; NICU, Neonatal intensive care unit, OGTT, oral glucose tolerance test.

P-values were calculated using non-parametric tests. Statistically significant P-values are shown in bold.

normal glucose tolerance. Demographic and perinatal characteristics of the GDM and control groups were summarized in Table 1. There were no clinically significant differences between the groups in terms of age, gravidity, parity, abortions, body mass index, gestational age at OGTT, preterm birth rate, the presence of diabetic ketoacidosis, gestational age at delivery, mode of delivery, Apgar scores at first and fifth minutes, NICU admission. The rates of polyhydramnios and macrosomia were significantly higher in GDM group as compared to the control group. Similarly, birth weight was higher in GDM group.

Laboratory characteristics of the GDM and control groups were presented in Table 2. Hemoglobin, AST, blood urea nitrogen, creatinine and platelet levels did not differ between GDM and control groups. Fasting glucose, 50 gram OGTT values, HbA1c values, ALT levels were significantly higher in GDM group. The median APRI score was significantly higher in the GDM group compared with the control group [0.24 (0.08–0.71) vs. 0.19 (0.06–1.14), P<0.001]. Similarly, the median FIB-4 index was also higher in women who later developed GDM [0.63 (0.16–2.39) vs. 0.59 (0.15–3.72), P=0.027].

ROC curve analysis demonstrated that a first-trimester APRI score >0.22 predicted the development of GDM with 61.46% sensitivity and 66.02% specificity (AUC=0.667, P<0.001) (Figure 1a and Figure 1b). For the FIB-4 index, a cut-off value of >0.53 predicted GDM with 66.31% sensitivity and 41.00% specificity (AUC=0.535, P=0.027). Comparative ROC analysis showed that the APRI score had a significantly higher predictive value for GDM than the FIB-4 index (P<0.001) (Figure 2). Correlation analysis revealed that the APRI score was not significantly correlated with maternal age, parity, fasting plasma glucose, or 50-g OGTT values. However, a weak positive correlation was observed between APRI and the FIB-4 index. In contrast, the FIB-4 index showed weak but statistically significant positive correlations with maternal age and parity, in addition to its correlation with the APRI score (Table 3).

## DISCUSSION

The present study evaluated the predictive value of first-trimester APRI score and FIB-4 index for GDM and demonstrated that both indices were significantly higher in women who subsequently developed GDM. Notably, APRI exhibited superior predictive performance compared with FIB-4, suggesting that

**TABLE 2. Laboratory Characteristics of the GDM and Control Groups**

| | GDM (n=371) | Control (n=2934) | P-value |
|---|---|---|---|
| **Fasting blood glucose (mg/dL)** | 94 (60-203) | 81 (53-125) | **<0.001** |
| **50-g OGTT (mg/dL)** | 157 (52-366) | 97 (57-138) | **<0.001** |
| **Hemoglobin (g/dL)** | 12.36±2.48 | 11.92±3.32 | 0.076 |
| **HbA1c (%)** | 5.2 (4.5-8.1) | 4.01 (3.79-5.43) | **0.038** |
| **AST (IU/L)** | 16 (5-47) | 16 (7-70) | 0.636 |
| **ALT (IU/L)** | 13 (3-38) | 11 (3-50) | **<0.001** |
| **BUN (mg/dl)** | 5 (3-19) | 6 (4-16) | 0.893 |
| **Creatinine (mg/dL)** | 0.63 (0.3-1.1) | 0.58 (0.3-0.9) | 0.283 |
| **Platelet ($10^3$/µL)** | 251 (104-495) | 244 (114-495) | 0.778 |
| **APRI score** | 0.24 (0.08-0.71) | 0.19 (0.06-1.14) | **<0.001** |
| **FIB4 score** | 0.63 (0.16-2.39) | 0.59 (0.15-3.72) | **0.027** |

Data are shown as mean±standard deviation or median (range). ALT, alanine aminotransferase; AST, aspartate aminotransferase; APRI, AST-to-platelet ratio index; BUN, blood urea nitrogen; FIB-4: fibrosis-4 index; GDM, gestational diabetes mellitus; HbA1c, Hemoglobin A1c; OGTT, oral glucose tolerance test.

P-values were calculated using appropriate parametric or non-parametric tests. Statistically significant P-values are shown in bold.

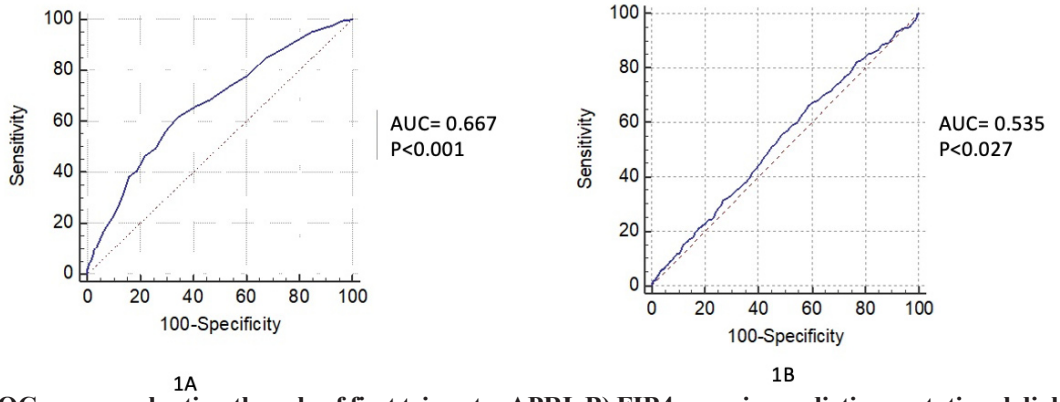


**FIGURE 1.** **A) ROC curve evaluating the role of first trimester APRI. B) FIB4 score in predicting gestational diabetes mellitus.**

simple liver-related composite indices obtained early in pregnancy may reflect underlying metabolic and inflammatory vulnerability preceding the clinical onset of glucose intolerance.

Gestational diabetes mellitus is increasingly recognized as a manifestation of systemic metabolic dysfunction rather than an isolated disorder of glucose metabolism. Insulin resistance, chronic low-grade inflammation, oxidative stress, and endothelial dysfunction play central roles in GDM pathophysiology and are closely linked to hepatic metabolic stress. Previous studies have demonstrated that women who later develop GDM already exhibit subtle alterations in liver enzymes and inflammatory markers during the first trimester, prior to routine GDM screening [13, 14]. A growing body of literature supports a bidirectional relationship between GDM and non-alcoholic fatty liver disease. Large observational studies and Mendelian randomization analyses have shown that NAFLD increases the risk of GDM, while GDM itself predisposes women to future NAFLD independently of obesity and traditional metabolic risk factors [8, 15–17]. These shared mechanisms highlight the overlap between hepatometabolic stress and glucose dysregulation.

The superior predictive performance of APRI observed in this study may be explained by its closer association with inflammation-related pathways. APRI incorporates both AST levels and platelet count, parameters influenced by systemic inflammation, endothelial dysfunction, and subclinical hepatocellular injury. In hepatic fibrosis, hepatocellular damage leads to increased AST levels, followed by a gradual decline in platelet count, resulting in elevated APRI scores [18]. Although an APRI score above 3 has been proposed as a marker of significant liver injury, advanced fibrosis is unlikely in young pregnant populations [19]. Therefore, elevated APRI values

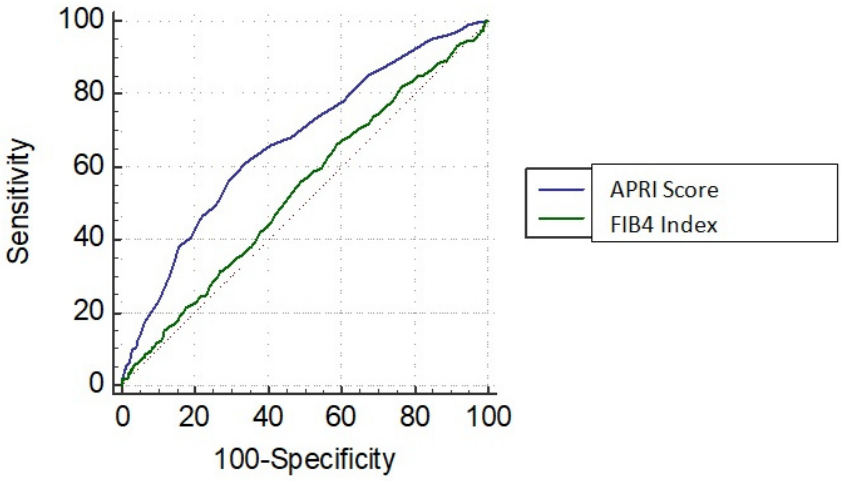


**FIGURE 2.** **ROC curve evaluating the role of first trimester FIB4 score in predicting gestational diabetes mellitus.**

**TABLE 3. Analysis Showing the Correlation of APRI and FIB4 Scores with Demographic and Laboratory Findings in GDM**

| | APRI score | FIB-4 score | Age | Parity | Fasting blood glucose | 50-g OGTT |
|---|---|---|---|---|---|---|
| **APRI score** | 1.000 | 0.515** | 0.017 | 0.006 | −0.029 | 0.042 |
| **FIB-4 score** | 0.515** | 1.000 | 0.398** | 0.271** | −0.035 | 0.046 |
| **Age (years)** | 0.017 | 0.398** | 1.000 | 0.555** | −0.043 | 0.107* |
| **Parity** | 0.006 | 0.271** | 0.555** | 1.000 | 0.012 | 0.054 |
| **Fasting blood glucose** | −0.029 | −0.035 | −0.043 | 0.012 | 1.000 | 0.267** |
| **50-g OGTT** | 0.042 | 0.046 | 0.107* | 0.054 | 0.267** | 1.000 |

APRI, AST-to-platelet ratio index; FIB-4, fibrosis-4 index; GDM, gestational diabetes mellitus; OGTT, oral glucose tolerance test.

*Correlation is significant at the 0.05 level (2-tailed),

**Correlation is significant at the 0.01 level (2-tailed)

during early pregnancy may instead reflect subclinical hepatocellular injury and inflammation associated with underlying metabolic stress, thereby contributing to the observed association with GDM.

Previous studies evaluating APRI in GDM have reported inconsistent results. While Ibanoğlu *et al.* found no significant difference in first-trimester APRI scores between women with GDM and controls, our findings support a significant association between elevated APRI and subsequent GDM development [9]. Differences between studies may be related to variations in glycemic regulation, study populations, baseline hepatic metabolic status, and sample size. Importantly, APRI has also been shown to be useful in pregnancy-related conditions characterized by hepatic dysfunction, such as intrahepatic cholestasis of pregnancy and HELLP syndrome, supporting its relevance as a marker of hepatometabolic stress during pregnancy [20, 21].

To date, most studies evaluating APRI and FIB-4 scores in pregnant women have primarily focused on intrahepatic cholestasis of pregnancy and preeclampsia [20, 22]. In the literature, only one study has specifically investigated the association between FIB-4 score and GDM. In that study, FIB-4 scores were significantly higher in women with GDM compared with controls, and the index predicted GDM with an area under the curve of 0.577. Moreover, higher FIB-4 scores were reported to be associated with adverse perinatal outcomes and increased mortality [10]. These findings, in line with previous evidence, support the presence of hepatic fibrotic and hepatometabolic alterations in GDM. In addition, the increased prevalence of GDM among women with non-alcoholic fatty liver disease further supports the link between GDM and underlying hepatic dysfunction [23, 24].

In this large retrospective cohort of 3,305 pregnant women, first-trimester APRI and FIB-4 indices were significantly higher in those who subsequently developed GDM, supporting the concept that hepatometabolic alterations precede the clinical onset of glucose intolerance. Notably, APRI demonstrated a moderate but clinically meaningful predictive performance (AUC=0.667), whereas FIB-4 showed only limited discriminative ability (AUC=0.535), highlighting the differential utility of these indices. The identified APRI cut-off (>0.22) provided a balanced sensitivity and specificity, suggesting its potential role as a practical early screening adjunct. Importantly, the lack of strong correlations between APRI and conventional clinical parameters further suggests that APRI may capture subclinical inflammatory and hepatocellular stress pathways not reflected by traditional risk factors. These findings are consistent with recent studies demonstrating that early pregnancy liver biomarkers are associated with subsequent GDM risk and may reflect underlying hepatometabolic dysfunction preceding overt disease [25]. Moreover, emerging evidence suggests that APRI and FIB-4 indices behave as dynamic markers of metabolic stress in insulin-resistant states, further supporting their

relevance beyond advanced fibrosis [26].

Although APRI and FIB-4 were originally developed to assess hepatic fibrosis in non-pregnant populations, accumulating evidence suggests that these indices primarily reflect systemic metabolic and inflammatory burden rather than advanced fibrosis in young individuals. Pregnancy has been described as a "metabolic stress test," capable of unmasking latent cardiometabolic and hepatometabolic vulnerability. Therefore, the comparatively lower predictive performance of FIB-4 in GDM may be related to its greater dependence on age and long-term fibrotic processes rather than acute metabolic stress. In our study, FIB-4 scores were significantly higher in women with GDM; however, the index showed a significant correlation with maternal age and parity, whereas APRI was not associated with clinical variables. Moreover, our direct ROC comparison demonstrated superior discriminative ability of APRI over FIB-4.

### Strengths and Limitations

The main limitations of this study include its retrospective and single-center design. In addition, the absence of imaging-based or histological confirmation of hepatic fibrosis precludes direct assessment of liver pathology. However, the primary aim of this study was not to diagnose hepatic fibrosis but to evaluate the predictive value of composite indices reflecting early metabolic stress.

## CONCLUSION

In conclusion, both APRI score and FIB-4 index were associated with the development of GDM, with APRI demonstrating superior predictive performance. These findings suggest that early pregnancy assessment of simple liver-related indices may contribute to improved risk stratification for GDM. Prospective, multicenter studies are warranted to validate these results.

*Ethics Approval and Consent to Participate*

This study was approved by the University of Health Sciences, Bursa Yüksek İhtisas Training and Research Hospital Medical Sciences Ethics Committee. (Decision No: 2024-TBEK 2025/03-12; date: 26.03.2025). All procedures were conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments. Due to the retrospective design, informed consent was waived.

*Data Availability*

The data that support the findings of this study are available on request from the corresponding author, upon reasonable request.

*Authors' Contribution*

Study Conception: GÖ, ŞKE; Study Design: GÖ; Supervision: BD; Funding: ŞKE,EKG; Materials: ŞKE, BD; Data Collection and/or Processing: ŞKE; Statistical Analysis and/or Data Interpretation: ŞKE, EKG; Literature Review: ŞKE; Manuscript Preparation: GÖ, NKE; and Critical Review: BD, NKE.

*Conflict of Interest*

The author(s) disclosed no conflict of interest during the preparation or publication of this manuscript.

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During the preparation of this work, the authors used ChatGPT (OpenAI, San Francisco, CA, USA) to assist with language editing. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication. The all content of the study was produced by the author(s) in accordance with scientific research methods and academic ethical principles.

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