

ORIGINAL RESEARCH

DOI: 10.62838/ASMJ.2025.2.03

Comparison of caries preventive efficacy and parent perception of silver diamine fluoride and glass ionomer cement in atraumatic restorative treatment: 12 month follow up study.

Sivadas Ganapathy¹, Shilpa Prabhakar Hiremath², Dhanraj Kalaivanan³, Sathiyavathi Mahendra Kumar⁴, Manu Unnikrishnan¹, Rajeev Arunachalam¹

¹ AIMST University, Malaysia.

² Smile bright Pediatric specialty clinic, Bangalore, India.

³ Sathyabama University Dental College and Hospital, India.

⁴ Best Dental Science College, India.

Abstract

Early childhood caries (ECC) is a global public health issue that is present worldwide and its effects have a significant impact on the overall health and quality of life. Atraumatic restorative treatment (ART) is a low-cost alternative to increase the accessibility of restorative treatment in these children. Conventionally glass ionomer cement (GIC) has been used in ART. Off late Silver diamine fluoride (SDF) is widely used in management of carious lesion.

Objectives: To compare the efficacy and parent perception of SDF and GIC in ART.

Results: Total of 46 patients were selected for each group. In SDF group 84% (n=39) were used for posteriors, while only 15% (n=7) were used for anterior teeth. In GIC group 91% (n=42) were used for restoration of posteriors, while only 9% (n=4) were used for anterior teeth. The criteria for procedure evaluation included ease of application and time for application which was significant in both the groups ($p < 0.001$). The mean time for SF group was 120 seconds, while in the GIC group was around 350 seconds. For esthetic evaluation the discoloration and the overall outcome was also significant in both the groups ($p < 0.001$). Complications during the procedure such as pain, redness, and acceptable taste were also noted. These values were also significant in both the groups ($p < 0.001$).

Conclusion: SDF could be used as suitable alternative to GIC in ART in situations such as children with uncooperative behavior. However, a larger sample should be studied with longer follow up to emphasize the success and longevity of SDF when compared to GIC.

Keywords: Early childhood caries, Silver diamine fluoride, Glass ionomer cement, atraumatic restorative treatment, Caries risk.

Introduction

Early childhood caries (ECC) is a global public health issue that is present worldwide and exhibits a more pronounced severity in communities characterized by low socioeconomic status. In these communities, caries lesions frequently go untreated, resulting in a significant impact on the overall health and quality of life with discomfort and pain, thereby further hindering physical development and diminishing children's capacity for learning. The age and child's cooperating ability makes it challenging to manage the carious lesions in them. Additionally, the lack of treatment leads to increased costs for future interventions [1,2].

Atraumatic restorative treatment (ART) is a low-cost alternative to increase the accessibility of restorative treatment in these children. It is

well-accepted by them, can be used in situations without electricity or running water, and has proven helpful in caries prevention. ART is a different approach for improving oral health where the access to dental care is limited, and it has been adopted in various nations. It is an interim procedure where in the cavities are restored with Glass ionomer cement (GIC). The GIC releases fluoride and the nutrition to the carious lesion is cut off the completely sealing the cavities. These aid in managing carious lesions with minimal intervention [3].

Many silver compounds have been tried in the field of dentistry due to its antimicrobial and cariostatic properties. Even though there was a brief period of decline in usage of these products due to ease of application and low cost it had regained popularity in the field of

dentistry [4,5]. Silver diamine fluoride (SDF) is a colorless alkaline liquid which exerts its antimicrobial property by the destruction of cell wall structure, denaturation of the cytoplasmic enzyme, and inhibition of microbic DNA replication. The high fluoride concentration and increased depth of penetration makes it more effective anticariostatic agent. Consequently, SDF has been recognized as a safe, effective, and economical cariostatic agent; as such, its use in the treatment of dental caries aligns with the principles of minimally invasive dentistry (MID) [5,6].

Aims and Objectives:

The aims of the present study were to compare the efficacy of SDF as an alternative to GIC in ART and compare the parent perception of SDF as an alternative to GIC in ART. The objective of the study was to find out if SDF can be an alternative to GIC in ART.

Material and methods

Children of age group 4 to 10 years with ICDAS score 5 on primary teeth with definitely positive category were included in the study.

Medically compromised patients and those with pain as chief complain were excluded from the list.

Institutional ethical committee clearance was obtained prior to the commencement of the study. The study design was conducted as experimental design under controlled conditions and the investigation comprised of children with multi surface caries on primary teeth, corresponding to International Caries Detection and Assessment System 5 (ICDAS 5) for occlusal and smooth surfaces.

A single calibrated investigator selected the participants for the treatment. The sample calculation for this study was done using the PS Power and Sample Size Program (Dupont and Plummer,1990) for two proportions equation, based on a minimally important difference of 25% in the success rates at 6 months between SDF and control, a type 1 error of 5% and power of 80%. A minimum sample of 50 children in each group were selected for the study. After the initial examination, the children meeting the inclusion criteria were randomly assigned to the experimental group ($n = 50$) (SDF) and the control group ($n = 50$) (GIC).

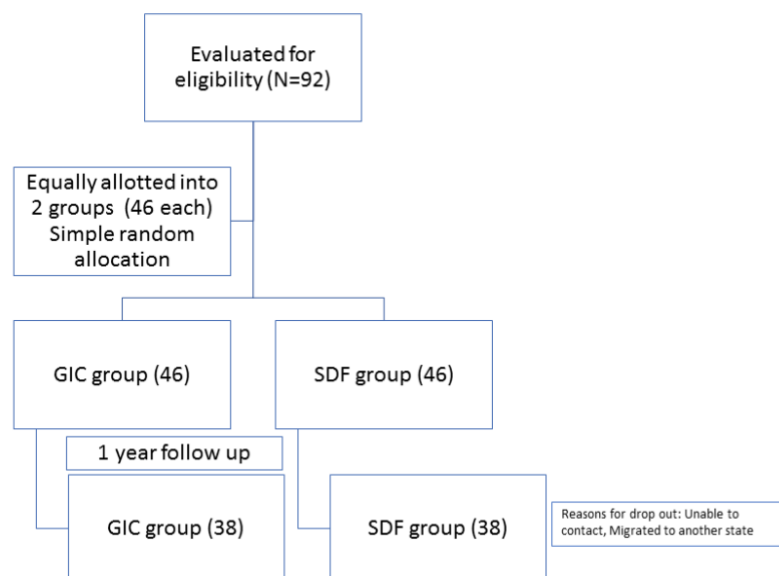


Figure 1. Flowchart: Evaluation, enrollment, randomization, dropout, and completion of participants

Before treatment, the children underwent a supervised tooth brushing session with fluoridated toothpaste.

For caries treatment techniques, the unsupported enamel or caries was not removed for both techniques. Cotton rolls were used to isolate the teeth from saliva and, for the GIC group, cavity conditioner (GC Corporation, Tokyo, Japan) was used before sealing the cavities with GIC (GC FUJI IX GP, GC America, Inc.). All participants were advised not to eat or drink for 1 hour after treatment.

For the 38% SDF (Kids e Dental LLP, Mumbai, India) treatment, vaseline was applied to the soft tissues in order to avoid contact lesions caused by the caustic properties of SDF. The SDF solution was left in contact with the tooth surface for 3 min, after which the child was asked to rinse the mouth with water. The criterion used to classify active caries lesions in the SDF group was based on the classic study of Miller. The fabric with hard consistency and dark colour was considered as inactive caries. Active caries was recorded when the probe, applied with light force, easily penetrated the dentine. Arrested caries was recorded if dentine cannot not be penetrated by the probe. For the other group, the

retention of GIC was evaluated by its resistance to probing.

According to Kidd, perfect sealing of the cavity with filling material, such as GIC, can arrest dentine caries. Thus, dentine caries is arrested when restorative material was present in the evaluation after 12 months.

For data analysis, descriptive statistical techniques and the chi-squared test and Fisher's exact tests were used with a margin of error of 5.0%. Data was stored on an EXCEL spreadsheet and statistics were calculated using the Statistical Package for the Social Sciences (SPSS) version 15 (IBM, Chicago, IL, USA).

For comparison of effectiveness, ease of application was recorded as 1 to -1 (mild, moderate and difficult) respectively. In esthetic assessment hard and soft tissue discoloration along with overall outcome was recorded as 1 to -1 (mild, moderate and severe) respectively. Complications during the application was measured in terms of pain, redness and signs of allergy. The outcome was recorded as 1 to -1 (mild, moderate and severe) respectively. The validated questionnaire was adopted from Bagher SM et al. [7].

Results

Table 1. Descriptive statistics for Material and Surface of application

Variable	n (%)
Material	
SDF	46 (50.0)
GIC	46 (50.0)
Surface-SDF	
Anterior	7 (15.2)
Posterior	39 (84.2)
Surface-GIC	
Anterior	4 (8.7)
Posterior	42 (91.3)

Table 1 shows the descriptive statistics. Total of 46 patients were selected for each group. In SDF group 84% (n=39) were posterior teeth,

while only 15% (n=7) were anterior teeth. In GIC group 91% (n=42) were posteriors, while only 9% (n=4) were anterior teeth.

Table 2. Comparison of effectiveness and parent perception of SDF & GIC

Question	SDF (n=46) Mean (Standard deviation)	GIC (n=46) Mean (Standard deviation)	P Value
Procedure evaluation			
1. Ease of application	1.61 (0.49)	1 (0.00)	<0.001
2. Time	120 (0.00)	336 (77.4)	<0.001
Esthetics			
1. I am comfortable with tooth discoloration after procedure	0.91 (0.78)	0 (0.00)	<0.001
2. I am comfortable with the discoloration of the gums	0.74 (0.71)	0 (0.00)	<0.001
3. I am satisfied with the overall outcome of the procedure	0.48 (0.69)	1 (0.00)	<0.001
Complication			
1. Procedure was pain free	0.39 (0.49)	0 (0.00)	<0.001
2. The taste of was acceptable	0.48 (0.69)	1 (0.00)	<0.001
3. No signs of allergy/redness on mucosa	0 (0.00)	0 (0.00)	
Overall score	0.13 (1.47)	0 (0.00)	0.55

Table 2 shows the comparison of effectiveness and parent perception of SDF & GIC groups. For procedure evaluation ease of application and time for application was significant in both the groups ($p < 0.001$). The mean time for SF group was 120 seconds, while in the GIC group was around 350 seconds. For

esthetic evaluation the discoloration and the overall outcome was also significant in both the groups ($p < 0.001$). Complications during the procedure such as pain, redness, and acceptable taste were also noted. These values were also significant in both the groups ($p < 0.001$).

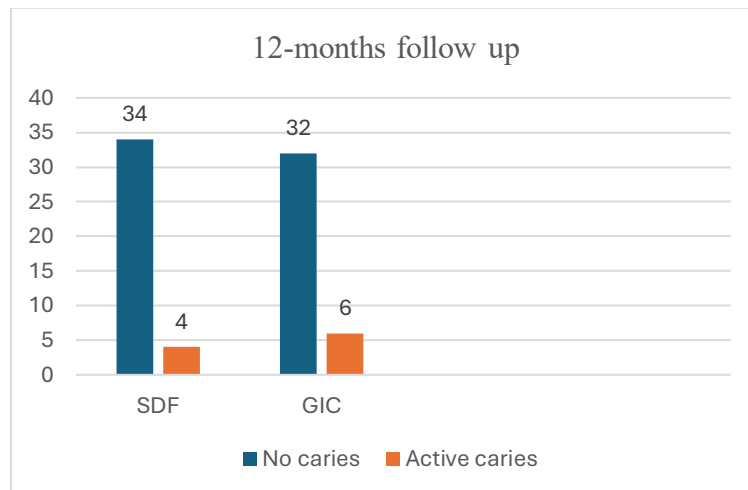


Figure 2. 12 months follow up for caries arresting ability in SDF and GIC

Figure 2 shows 12 months follow up for caries arresting ability in SDF and GIC group. In SDF group out of 46 participants, 8 participants dropped out and there was active caries in 4 teeth. In GIC group out of 46 participants, 8 participants dropped out and there was active caries in 6 teeth due to fractures restoration.

Discussion

The notable decrease in dental caries observed in numerous affluent nations during the previous thirty years can be primarily ascribed to the prevalent utilization of fluoride toothpaste, despite the ongoing intake of substantial quantities of sugar [8]. The presence of untreated dental caries poses a negative effect on the overall quality of life in young children, specifically in relation to oral health. This in turn can result in various complications such as pain, abscess formation, and the occurrence of systemic symptoms including fever and lymphadenopathy [9]. Severe consequences, such as the dissemination of odontogenic infections to anatomical regions of the cranium and cervical region, may also arise [10].

Atraumatic restorative treatment (ART) is a minimally invasive approach for the management of carious lesions that entails the elimination of demineralized tissue solely employing manual instruments to minimize discomfort [3,11]. Silver diamine fluoride (SDF) and atraumatic restorative treatment (ART) are encompassed within this framework and are designed to optimize tooth preservation while minimizing psychological distress experienced by the patient [12]. The utilization of these methodologies assumes a crucial function in enhancing the overall oral well-being of young individuals, specifically in regions where accessibility to regular dental care is limited [13]. Silver diamine fluoride (SDF) is commonly known as the "silver-fluoride bullet" owing to its capacity to halt the advancement of caries while concurrently impeding the development of fresh lesions. This cost-effective topical solution proves efficacious through a synergistic mechanism involving the induction of sclerotic dentine by silver salt, the potent germicidal activity of silver nitrate, and the facilitation of remineralization aided by fluoride [6,14,15]. It requires minimal training, and personnel, and is especially useful in very young children who are uncooperative [16].

In contrast, ART involves removal of decayed tissue using hand instruments followed by restoration of the cavity with an adhesive material, mostly, GIC. This painless and cost-effective technique produces lesser dental anxiety, has high acceptance in children, produces a good seal, and replaces the damaged tooth tissue. Additionally, it includes placement of ART sealants which involve sealing the carious pits and fissures under finger pressure using hand instruments [13,16].

The deferral of regular dental services amid the COVID-19 pandemic has unavoidably resulted in a substantial accumulation of children suffering from untreated dental caries. Consequently, current recommendations have emphasized the utilization of SDF and ART for managing and halting caries development in both primary and permanent teeth. Thus, we conducted a comparison to ascertain the effectiveness of caries prevention between SDF and GIC [17].

Researchers have found that SDF is as effective as GIC in arresting caries in primary teeth at 1 year follow up. Few studies have shown that SDF is more effective than GIC at 1 year follow up. The concentration of SDF in these studies ranged from 30-38% [8,18,19]. In permanent teeth as low as 10% was found to be effective in arresting caries [20]. These studies highlight the effectiveness of SDF as a suitable alternative to GIC.

In our investigation, the utilization of Silver Diamine Fluoride (SDF) demonstrated a greater degree of simplicity and expeditiousness when juxtaposed with the conventional Atraumatic Restorative Treatment (ART) using Glass Ionomer Cement (GIC). This observation aligns with the findings of a preceding study conducted by Abdellatif et al. in 2021 [21]. The abbreviated duration of treatment ascertained in our study bestows a noteworthy advantage, particularly in the treatment of young children. Furthermore, the straightforwardness of the procedure and the potential discomfort

experienced by the patient should also be considered when confronted with challenges pertaining to behavioral or medical management. Although the economic disparity between the two treatments was not examined in our current study, it is worth mentioning that the cost of employing high-viscosity glass ionomer for ART restorations is nearly twentyfold compared to the cost of SDF. This exorbitant cost would impede its utilization among the underprivileged population. It is important to note that while SDF effectively halts the progression of caries, it does not restore the form and function of the affected tooth. Notably, our study did not address the issues of cost, operator proficiency, restoration of tooth form, function, and aesthetics as primary outcomes. These well-established issues in both SDF and ART modalities merit careful consideration when selecting an appropriate treatment option [19,22].

In our present investigation, the contentment of parents regarding the consequences, such as esthetics and the outcome of the procedure, between SDF and GIC was observed. This observation is consistent with the other studies [23]. The significance of esthetics cannot be overlooked, as it has been demonstrated to be a primary concern for parents when selecting SDF treatment. The cost of treatment is also a significant consideration. Consequently, there is a higher preference for posterior teeth to be treated with SDF. In our investigation, there was a lower proportion of anterior teeth compared to posterior teeth, which may have contributed to the increased acceptance of SDF by parents when compared to GIC. This finding aligns with the results of a prior investigation conducted by Wajahat et al. [24]. These findings underscore the adaptability of the participants in the current population towards emerging treatments and highlight aesthetic concerns as a major hindrance in this aesthetically driven society. These findings provide support for the notion that most parents favor SDF over advanced pharmacological behavioral management

techniques, such as sedation and general anesthesia [25,26].

Conclusion & Limitation:

ART is a procedure that has gained popularity as it manages carious lesion by acting as desensitization for young children. Ever since the reintroduction of SDF it has received great acceptance since its cost effective, easy to apply and arrests carious lesions in primary and permanent teeth. The only disadvantage of SDF being the discoloration, which outweighs its benefits. Since SDF reduces the treatment time and has an acceptable parent perception, it could be used as an alternative to GIC in ART. Further larger samples with more long term follows are recommended in future to have more conclusive evidence.

Conflict of interest: None to declare.

References

1. Saikia A, Aarthi J, Muthu MS, Patil SS, Anthonappa RP, Walia T, et al. Sustainable development goals and ending ECC as a public health crisis. *Front Public Health*. 2022 Oct 18;10:931243. doi:10.3389/fpubh.2022.931243.
2. Gao SS, Chen KJ, Duangthip D, Wong MCM, Lo ECM, Chu CH. Preventing early childhood caries with silver diamine fluoride: study protocol for a randomised clinical trial. *Trials*. 2020 Feb 4;21(1):140. doi:10.1186/s13063-020-4088-7.
3. Wakhloo T, Reddy SG, Sharma SK, Chug A, Dixit A, Thakur K. Silver diamine fluoride versus atraumatic restorative treatment in pediatric dental caries management: a systematic review and meta-analysis. *J Int Soc Prev Community Dent*. 2021 Jul 3;11(4):367–75. doi:10.4103/jispcd.JISPCD_83_21.
4. Fernandez CC, Sokolonski AR, Fonseca MS, Stanisic D, Araújo DB, Azevedo V, et al. Applications of silver nanoparticles in dentistry: advances and technological innovation. *Int J Mol Sci*. 2021 Mar 2;22(5):2485. doi:10.3390/ijms22052485.
5. Mungur A, Chen H, Shahid S, Baysan A. A systematic review on the effect of silver diamine fluoride for management of dental caries in permanent teeth. *Clin Exp Dent Res*. 2023 Apr;9(2):375–87. doi:10.1002/cre2.716.
6. Zheng FM, Yan IG, Duangthip D, Gao SS, Lo ECM, Chu CH. Silver diamine fluoride therapy for dental care. *Jpn Dent Sci Rev*. 2022 Nov;58:249–57. doi:10.1016/j.jdsr.2022.08.001.
7. Bagher SM, Sabbagh HJ, AlJohani SM, Alharbi G, Aldajani M, Elkhodary H. Parental acceptance of the utilization of silver diamine fluoride on their child's primary and permanent teeth. *Patient Prefer Adherence*. 2019 May 23;13:829–35. doi:10.2147/PPA.S205686.
8. Marthaler TM, O'Mullane DM, Vrbic V. The prevalence of dental caries in Europe 1990–1995. *ORCA Saturday afternoon symposium 1995. Caries Res*. 1996;30(4):237–55. doi:10.1159/000262332.
9. Vollú AL, Rodrigues GF, Rougemont Teixeira RV, Cruz LR, Dos Santos Massa G, de Lima Moreira JP, et al. Efficacy of 30% silver diamine fluoride compared to atraumatic restorative treatment on dentine caries arrestment in primary molars of preschool children: a 12-months parallel randomized controlled clinical trial. *J Dent*. 2019 Sep;88:103165. doi:10.1016/j.jdent.2019.07.003.
10. Miglani S. Burden of dental caries in India: current scenario and future strategies. *Int J Clin Pediatr Dent*. 2020 Mar–Apr;13(2):155–9. doi:10.5005/jp-journals-10005-1733.
11. Giacaman RA, Muñoz-Sandoval C, Neuhaus KW, Fontana M, Chafas R. Evidence-based strategies for the minimally invasive treatment of carious lesions: review of the literature. *Adv Clin Exp Med*. 2018 Jul;27(7):1009–16. doi:10.17219/acem/77022.
12. Cianetti S, Pagano S, Nardone M, Lombardo G. Model for taking care of patients with early childhood caries during the SARS-CoV-2 pandemic. *Int J Environ Res Public Health*. 2020 May 26;17(11):3751. doi:10.3390/ijerph17113751.
13. Dorri M, Martinez-Zapata MJ, Walsh T, Marinho VC, Sheiham A, Zaror C. Atraumatic restorative treatment versus conventional restorative treatment for managing dental caries. *Cochrane Database Syst Rev*. 2017 Dec 28;12(12):CD008072. doi:10.1002/14651858.CD008072.pub2.
14. Rosenblatt A, Stamford TC, Niederman R. Silver diamine fluoride: a caries “silver-fluoride bullet”. *J Dent Res*. 2009 Feb;88(2):116–25. doi:10.1177/0022034508329406.
15. Chibinski AC, Wambier LM, Feltrin J, Loguercio AD, Wambier DS, Reis A. Silver diamine fluoride has efficacy in controlling caries progression in primary teeth: a systematic review and meta-analysis. *Caries Res*. 2017;51(5):527–41. doi:10.1159/000478668.
16. Chu CH, Lo EC. Promoting caries arrest in children with silver diamine fluoride: a review. *Oral Health Prev Dent*. 2008;6(4):315–21.
17. Eden E, Frencken J, Gao S, Horst JA, Innes N. Managing dental caries against the backdrop of COVID-19: approaches to reduce aerosol generation. *Br Dent J*. 2020 Oct;229(7):411–6. doi:10.1038/s41415-020-2153-y.

18. Zhi QH, Lo EC, Lin HC. Randomized clinical trial on effectiveness of silver diamine fluoride and glass ionomer in arresting dentine caries in preschool children. *J Dent.* 2012 Nov;40(11):962–7. doi:10.1016/j.jdent.2012.08.002.
19. Dos Santos VE Jr, de Vasconcelos FM, Ribeiro AG, Rosenblatt A. Paradigm shift in the effective treatment of caries in schoolchildren at risk. *Int Dent J.* 2012 Feb;62(1):47–51. doi:10.1111/j.1875-595X.2011.00088.x.
20. Braga MM, Mendes FM, De Benedetto MS, Imparato JC. Effect of silver diammine fluoride on incipient caries lesions in erupting permanent first molars: a pilot study. *J Dent Child (Chic).* 2009 Jan–Apr;76(1):28–33.
21. Abdellatif HM, Ali AM, Baghdady SI, ElKateb MA. Caries arrest effectiveness of silver diamine fluoride compared to alternative restorative technique: randomized clinical trial. *Eur Arch Paediatr Dent.* 2021 Aug;22(4):575–85. doi:10.1007/s40368-020-00592-0.
22. Kodali PB, Hegde V, Minhaz R, Mithra PP, Alva S, Joseph JS, et al. Cost-effective analysis of silver diamine fluoride in comparison to glass ionomer cement along with fluoride varnish in the management of early childhood caries in Anganwadi centers of Mangalore: a randomized control trial. *J Indian Assoc Public Health Dent.* 2022 Oct;20(4):420–6. doi:10.4103/jiaphd.jiaphd_221_21.
23. ElGhandour R, ElTekeya M, Sharaf A. Parental satisfaction after using silver diamine fluoride on their children's primary teeth: a randomized clinical trial. *Alexandria Dent J.* 2021;46(3):157–62. doi:10.21608/Adjalexu.2020.41649.1098.
24. Wajahat M, Abbas B, Tariq K, Imran E, Aslam S, Khurshid Z. Parental perception of silver diamine fluoride for the management of dental caries. *J Taibah Univ Med Sci.* 2022 Jan 5;17(3):408–14. doi:10.1016/j.jtumed.2021.11.010.
25. Younis SH, Elkordy AM, Alshazly NM. Success of early childhood caries after treatment with silver diamine fluoride compared to conventional glass ionomer restoration: a systematic review. *Future Dent J.* 2024;10(1):57–9. doi:10.54623/fdj.10110.
26. Al-Nerabieah Z, AlKhouli M, Dashash M. Parental satisfaction and acceptance of silver diamine fluoride treatment for molar incisor hypomineralisation in pediatric dentistry: a cross-sectional study. *Sci Rep.* 2024;14:4544. doi:10.1038/s41598-024-55456-0.

Corresponding author:

Dr.Sivadas Ganapathy

Associate Professor, Faculty of dentistry, AIMST University, Malaysia

Email: sivadas@aimst.edu.my

Phone number: +6017-6447241

Received: June 2, 2025/ Accepted: July 4, 2025