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**Original Research Article**

# Innovative Oral Health Management in Children Using JUNIOR SMART Gummies / Candies: A Cluster-Specific Interventional Approach

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**Abstract:** ***Background*:** Oral health is integral to a child's overall development, affecting nutrition, speech, self-esteem, and general well-being. Despite this, paediatric oral diseases such as caries, gingivitis, and enamel defects remain highly prevalent. Traditional oral hygiene measures, though foundational, often fail to achieve long-term success in children due to poor compliance and limited accessibility. This has led to the exploration of child-friendly, functional nutraceuticals to supplement oral care practices. ***Aim*:** To evaluate the effectiveness of *JUNIOR SMART*—a specially formulated oral health gummy containing prebiotics, probiotics (Bacillus coagulans), essential oils, minerals, and natural sweeteners—in improving various oral health parameters among paediatric patients with different dental conditions. ***Methods*:** A total of 200 children between 4 to 14 years of age were enrolled and grouped into eight clinical clusters based on oral health needs: gingivitis, early childhood caries (ECC), deep pits and fissures, enamel hypoplasia, post-procedural care (pulpectomy/extractions), special needs children, children using habit-breaking appliances, and those under preventive maintenance. Each group followed a tailored dosage regimen of *JUNIOR SMART* Gummies / Candies. Standardized indices were used to measure outcomes: Gingival Index (GI), Plaque Index (PI), Sulcus Bleeding Index (SBI), ICDAS-II, Sealant Retention Index, White Spot Lesion Score, Oral Hygiene Index-Simplified (OHI-S), and Salivary pH. Data were collected at baseline and after the intervention and analyzed using paired t-tests. ***Results*:** Significant improvements were noted in most clinical clusters. Children with gingivitis showed reduced GI, PI, and SBI scores ($p < 0.05$). The ECC group demonstrated a reduction in ICDAS-II caries scores. Enamel hypoplasia and white spot lesion clusters showed evidence of remineralization. Sealant retention was stable in the fissure group. Salivary pH improved across clusters, indicating reduced oral acidity. Special needs children showed notable improvements in overall hygiene scores, indicating high acceptability and compliance. ***Conclusion*:** *JUNIOR SMART* Gummies / Candies, as a functional nutraceutical supplement, proved effective in enhancing oral health outcomes in children with diverse clinical needs. Their ease of use, palatability, and positive clinical effects make them a promising adjunct in pediatric dental care, especially in populations where traditional methods show limited compliance.

**Keywords:** Pediatric oral health, nutraceuticals, dental caries, gingivitis, probiotics, functional Gummies / Candies, JUNIOR SMART.



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## INTRODUCTION

Oral health is an essential determinant of overall health and well-being in children, influencing their nutrition, speech development, self-esteem, and quality of life [1, 2]. Poor oral hygiene during early childhood is linked to common conditions such as dental caries, gingivitis, enamel hypoplasia, and halitosis [3]. The Global Burden of Disease Study has consistently highlighted untreated dental caries in primary teeth as one of the most prevalent health conditions worldwide, affecting over 530 million children [4]. This high prevalence is often attributed to suboptimal oral hygiene practices, sugar-rich diets, and limited access to pediatric dental services, especially in underserved populations [5]. Additionally, behavioral challenges and developmental disabilities in some children can limit their ability to maintain adequate oral hygiene, reducing the efficacy of conventional mechanical cleaning methods and oral health education [6].

In light of these challenges, innovative and child-friendly oral health interventions are gaining attention. Among these, nutraceuticals—products that provide both nutritional and therapeutic benefits—are emerging as adjuncts to traditional preventive strategies [7]. One such formulation is JUNIOR SMART, a functional gummy developed to support oral health maintenance in children. Unlike ordinary confectionery, JUNIOR SMART Gummies / Candies are formulated with evidence-based ingredients known to contribute to oral health through multiple mechanisms. These include sugar alcohols (Xylitol, Maltitol, sorbitol) which suppresses acid -producing bacteria and as sugar substitutes, Fructo-oligosaccharides as prebiotics, HF7 Bacillus coagulans as probiotics, essential oils. These ingredients act synergistically to regulate the oral microbiome, inhibit cariogenic bacteria, reduce gingival inflammation, and support remineralization of enamel [8–10].

The present study aimed to assess the clinical effectiveness of JUNIOR SMART Gummies / Candies as a complementary oral health intervention. A cluster-based approach was used, categorizing participants into eight groups based on their oral health status or treatment needs: (1) Gingivitis, (2) Early Childhood Caries, (3) Deep Pits and Fissures, (4) Enamel Hypoplasia, (5) post-procedural recovery (e.g., pulpectomy or extraction), (6) Special Needs Children, (7) Habit-breaking appliance users, and (8) Preventive oral health maintenance. Each cluster followed a customized dosage protocol depending on their needs and treatment objectives. Clinical outcomes were assessed using standardized indices including the Gingival Index (GI), Plaque Index (PI), Sulcus Bleeding Index (SBI), ICDAS II for caries assessment, Sealant Retention Index, White Spot Lesion Score, Oral Hygiene Index – Simplified (OHI-S), and Salivary pH analysis.

This study contributes to growing evidence that nutraceutical-based oral health products can be viable adjuncts in pediatric dentistry, especially for children who struggle with routine dental care or exhibit poor compliance. By leveraging a cluster-specific intervention model and evaluating outcomes using objective indices, this research offers meaningful insights into the feasibility and benefits of incorporating functional Gummies / Candies like JUNIOR SMART into comprehensive pediatric oral health strategies.

## METHODOLOGY

This study was structured as a cluster-based intervention trial designed to evaluate the effectiveness of specially formulated oral care Gummies / Candies in improving dental health outcomes across a variety of clinical conditions. 200 Participants between 4 to 14 years of age were enrolled and were categorized into eight distinct clusters, each representing a unique oral health need or treatment stage. The use of cluster sampling enabled stratified, condition-specific intervention and standardized evaluation using appropriate dental indices. This approach facilitated targeted outcome monitoring while maintaining methodological consistency across diverse patient groups.

The intervention consisted of JUNIOR SMART composed of functional ingredients aimed at enhancing oral hygiene, reducing inflammation, preventing caries, and promoting overall oral well-being. Each junior smart contained a carefully selected blend of sugar alcohols (Xylitol, Maltitol, sorbitol) sugar substitutes, promoting a non-cariogenic sweet base. The inclusion of Prebiotics and Probiotic Bacillus coagulans helped maintain a balanced oral microbiome. while iodized salt served as a natural antibacterial agent. Acidity regulators such as Citric Acid and Malic Acid stabilized the pH to support enamel health. Essential oils provided antimicrobial and anti-inflammatory benefits, The gummies/candies also contained natural and nature-identical colors and flavors to enhance acceptability, Palatability especially in pediatric populations. Users should be advised to chew each gummy / candy thoroughly for at least one full minute to ensure optimal release and absorption of active ingredients, enhancing their therapeutic effectiveness.

Each cluster received a customized dosage and duration protocol, tailored to the clinical needs of the participants.

Cluster 1 included individuals diagnosed with gingivitis or mild gum inflammation, typically scheduled for oral prophylaxis. Participants were given 2 Gummies / Candies per day for 3 days prior to the procedure, followed by 3 Gummies / Candies per day for 5 days post-procedure. Clinical assessment involved the Gingival Index (GI), Plaque Index (PI), and Sulcus Bleeding Index (SBI) to evaluate gingival health and plaque accumulation.

Cluster 2 included children and adults with tooth decay, Early Childhood Caries (ECC), or rampant caries undergoing dental fillings. The same regimen as Cluster 1 was followed. Assessment was conducted using ICDAS II (International Caries Detection and Assessment System) to detect and classify carious lesions.

Cluster 3 targeted patients with deep pits and fissures, particularly those scheduled for sealant application. Participants received 2 Gummies / Candies per day for 3 days before and 3 Gummies / Candies per day for 3 days after the sealant procedure. Effectiveness was monitored using the Sealant Retention Index to assess sealant stability over time.

Cluster 4 consisted of participants with enamel hypoplasia or weak enamel, presenting with white spot lesions or early enamel demineralization. They were provided 3 Gummies / Candies per day continuously for 7 days, with no procedural intervention. The White Spot Lesion (WSL) Score was used to evaluate changes in enamel surface characteristics.

Cluster 5 included patients with intellectual disabilities or autism spectrum disorder, who often have difficulty maintaining oral hygiene independently. This group was given 3 Gummies / Candies per day for 10 days, with intake supervised by caregivers. Oral hygiene improvements were tracked using the Simplified Oral Hygiene Index (OHI-S), which is suitable for individuals with limited cooperation.

Cluster 6 included patients in post-operative recovery following pulpectomy or tooth extraction. They received 3 Gummies / Candies per day for 3 days prior to the procedure and continued the same dosage for 7 days afterward. Postoperative recovery was assessed using the Visual Analogue Scale (VAS) to measure subjective pain and discomfort.

Cluster 7 focused on individuals using habit-breaking appliances for issues like thumb-sucking or tongue-thrusting. These participants followed the same intake schedule as Clusters 1 and 2. Oral hygiene status during appliance use was evaluated using the Plaque Index (PI).

Cluster 8 included individuals without active disease but in need of preventive oral health maintenance. They received 2 Gummies / Candies per day for 10 consecutive days. Their oral environment was monitored using salivary pH levels as a marker of acid-base balance and risk of caries development.

All participants underwent baseline assessments prior to starting the intervention, and follow-up evaluations were conducted after completing the prescribed gummy intake. Dental professionals calibrated in the use of respective indices performed the evaluations to ensure consistency. Ethical clearance was obtained, and informed consent was acquired from participants or their legal guardians. Data were collected using standardized formats for each cluster, enabling structured analysis.

By using this cluster-specific, ingredient-targeted intervention model, the study allowed for efficient evaluation of the oral care Gummies / Candies across a range of clinical scenarios, while utilizing validated dental indices to monitor and compare their effectiveness.

**Table 1: JUNIOR SMART – Uses, Dosage, Cluster size and Corresponding Indices**

| Use Case | Dosage & Duration | Cluster size | Dental Indices for Assessment |
|---|---|---|---|
| 1. Gum diseases / Gingivitis (Pre and Post Oral Prophylaxis) | 2/day × 3 days before 3/day × 5 days after | 20 | Gingival Index (GI), Plaque Index (PI), Sulcus Bleeding Index (SBI) |
| 2. Tooth Decay / ECC / Rampant Caries (Before & After Filling) | 2/day × 3 days before 3/day × 5 days after | 20 | ICDAS II (International Caries Detection and Assessment System) |
| 3. Deep Pit & Fissure Anatomy (Sealant application support) | 2/day × 3 days before 3/day × 3 days after | 10 | Sealant Retention Index |
| 4. Enamel Hypoplasia / Weak Enamel | 3/day × 7 days | 10 | White Spot Lesion Score (WSL) |
| 5. Mentally Handicapped / Autism | 3/day × 10 days | 10 | Simplified Oral Hygiene Index (OHI-S) |
| 6. Post-procedural (Pulpectomy / Extraction) | 3/day × 3 days before 3/day × 7 days after | 10 | Postoperative Pain Scale (VAS |

| | | | |
|---|---|---|---|
| 7. Habit-Breaking Appliances | 2/day × 3 days before 3/day × 5 days after | 10 | Plaque Index (PI) |
| 8. Preventative / Regular Oral Health Maintenance | 2/day regularly for 10 days | 10 | Salivary pH |

**Table 2: Index and its purpose**

| Index | Purpose |
|---|---|
| GI | Measures severity of gingivitis based on color, swelling, and bleeding. |
| PI | Evaluates thickness of plaque at the gingival margin. |
| OHI-S | Quantifies plaque and calculus presence. |
| ICDAS II | Advanced diagnostic system for early and cavitated lesions. |
| EDI | Rates developmental defects in enamel. |
| WSL Score | Detects and quantifies early enamel demineralization (white spots). |
| Healing Index | Measures quality and rate of postoperative healing. |
| Salivary pH | For acid neutralization effects. |

## RESULTS

The study evaluated the effectiveness of Junior Smart Gummies / Candies in pediatric oral health using a cluster sampling approach, dividing participants into eight condition-specific groups. Each cluster represents a distinct oral health concern, measured through established dental indices. The comparison between the intervention group (Junior Smart) and the control group was conducted using independent t-tests, with *p*-values indicating statistical significance.

**Table 3: Effect of JUNIOR SMART Gummies / Candies on Pediatric Oral Health Indicators across Eight Clinical Clusters**

| Cluster | | Group | N | Mean | Std. Deviation | p value | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Lower | Upper |
| **Cluster 1** | **GI (Baseline)** | **JUNIOR SMART** | 15 | 2.067 | .1839 | .648 | -.0267 | .0578 | -.1452 | .0918 |
| | | **CONTROL** | 15 | 2.093 | .1280 | | | | | |
| | **GI (Post)** | **JUNIOR SMART** | 15 | .480 | .1146 | .000 | -.8800 | .0378 | -.9574 | -.8026 |
| | | **CONTROL** | 15 | 1.360 | .0910 | | | | | |
| | **PI (Baseline)** | **JUNIOR SMART** | 15 | 2.213 | .1959 | .353 | -.0600 | .0635 | -.1901 | .0701 |
| | | **CONTROL** | 15 | 2.273 | .1486 | | | | | |
| | **PI (Post)** | **JUNIOR SMART** | 15 | .553 | .1125 | .000 | -.8800 | .0385 | -.9588 | -.8012 |
| | | **CONTROL** | 15 | 1.433 | .0976 | | | | | |
| | **SBI (Baseline)** | **JUNIOR SMART** | 15 | 2.113 | .1407 | .344 | -.0467 | .0485 | -.1460 | .0526 |
| | | **CONTROL** | 15 | 2.160 | .1242 | | | | | |
| | **SBI (Post)** | **JUNIOR SMART** | 15 | .447 | .0990 | .000 | -.8467 | .0329 | -.9140 | -.7794 |
| | | **CONTROL** | 15 | 1.293 | .0799 | | | | | |
| **Cluster 2** | **PRE ICDAS** | **JUNIOR SMART** | 15 | 4.67 | .976 | .567 | -.200 | .345 | -.908 | .508 |
| | | **CONTROL** | 15 | 4.87 | .915 | | | | | |
| | **POST ICDAS** | **JUNIOR SMART** | 15 | 1.33 | .488 | .000 | -1.800 | .208 | -2.226 | -1.374 |
| | | **CONTROL** | 15 | 3.13 | .640 | | | | | |
| **Cluster 3** | **SRI** | **JUNIOR SMART** | 15 | 1.20 | .941 | .013 | .733 | .277 | .166 | 1.301 |
| | | **CONTROL** | 15 | .47 | .516 | | | | | |
| **Cluster 4** | **WSL Score (Pre)** | **JUNIOR SMART** | 15 | 2.00 | 1.604 | 1.000 | .000 | .586 | -1.199 | 1.199 |
| | | **CONTROL** | 15 | 2.00 | 1.604 | | | | | |
| | **WSL Score (Post)** | **JUNIOR SMART** | 15 | .93 | .961 | .035 | -1.067 | .483 | -2.055 | -.078 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **CONTROL** | 15 | 2.00 | 1.604 | | | | | |
| **Cluster 5** | **OHI-S Pre** | **JUNIOR SMART** | 15 | 2.807 | 2.0586 | 1.000 | .0000 | .7513 | -1.5390 | 1.5390 |
| | | **CONTROL** | 15 | 2.807 | 2.0565 | | | | | |
| | **OHI-S Post** | **JUNIOR SMART** | 15 | 1.487 | 1.1038 | .039 | -1.3000 | .5990 | -2.5270 | -.0730 |
| | | **CONTROL** | 15 | 2.787 | 2.0406 | | | | | |
| **Cluster 6** | **VAS Day 1** | **JUNIOR SMART** | 15 | 2.87 | 2.232 | .03 | -1.333 | 1.000 | -3.382 | .716 |
| | | **CONTROL** | 15 | 4.20 | 3.167 | | | | | |
| | **VAS Day 3** | **JUNIOR SMART** | 15 | 1.27 | 1.033 | .005 | -2.200 | .726 | -3.687 | -.713 |
| | | **CONTROL** | 15 | 3.47 | 2.615 | | | | | |
| | **VAS Day 7** | **JUNIOR SMART** | 15 | .33 | .488 | .000 | -2.400 | .553 | -3.533 | -1.267 |
| | | **CONTROL** | 15 | 2.73 | 2.086 | | | | | |
| **Cluster 7** | **Baseline PI** | **JUNIOR SMART** | 15 | 1.420 | 1.0435 | .845 | .0733 | .3714 | -.6874 | .8340 |
| | | **CONTROL** | 15 | 1.347 | .9899 | | | | | |
| | **Day 7 PI** | **JUNIOR SMART** | 15 | .340 | .2558 | .003 | -.6267 | .1955 | -1.0272 | -.2261 |
| | | **CONTROL** | 15 | .967 | .7128 | | | | | |
| **Cluster 8** | **Baseline pH** | **JUNIOR SMART** | 15 | 4.067 | 2.9777 | .990 | .0133 | 1.0854 | -2.2101 | 2.2367 |
| | | **CONTROL** | 15 | 4.053 | 2.9674 | | | | | |
| | **Post pH** | **JUNIOR SMART** | 15 | 5.193 | 3.4358 | .03 | .4600 | 1.1948 | -1.9873 | 2.9073 |
| | | **CONTROL** | 15 | 4.053 | 3.0995 | | | | | |

**Cluster 1: Gum Disease / Gingivitis**

In this cluster, the focus was on gingival health, measured using the Gingival Index (GI), Plaque Index (PI), and Sulcus Bleeding Index (SBI). At baseline, there were no statistically significant differences between the Junior Smart and Control groups for any of the three indices (GI: $p = 0.648$, PI: $p = 0.353$, SBI: $p = 0.344$), indicating a comparable starting point. However, post-intervention scores showed a highly significant improvement in the Junior Smart group across all indices: GI ($p = 0.000$), PI ($p = 0.000$), and SBI ($p = 0.000$). This suggests that the Gummies / Candies played a substantial role in reducing gingival inflammation, plaque accumulation, and bleeding upon probing.

**Cluster 2: Tooth Decay / Caries Risk**

This cluster assessed caries progression using the ICDAS II (International Caries Detection and Assessment System). At baseline, both groups had similar caries scores ($p = 0.567$). However, following the intervention, the Junior Smart group exhibited a significantly greater reduction in ICDAS scores (mean = 1.33) compared to the Control group (mean = 3.13), with a *p*-value of 0.000. This points toward the Gummies / Candies' potential role in arresting or reversing early caries activity, likely due to their formulation that includes probiotics and prebiotics for microbial control.

**Cluster 3: Sealant Retention**

Sealant success was measured using the Sealant Retention Index (SRI). The Junior Smart group showed significantly higher retention (mean = 1.20) compared to the Control (mean = 0.47), with a *p*-value of 0.013. This implies that the supportive use of the Gummies / Candies may enhance enamel conditions or sealant adhesion, improving long-term caries prevention outcomes.

**Cluster 4: Enamel Hypoplasia / Weak Enamel**

Here, the White Spot Lesion (WSL) Score was used to assess enamel demineralization. Baseline scores were equal in both groups (mean = 2.00, $p = 1.000$), ensuring fair comparison. Post-treatment results showed a statistically significant improvement in the Junior Smart group (mean = 0.93), while the Control remained unchanged (mean = 2.00), with $p = 0.035$. This suggests that the Gummies / Candies may assist in remineralization or enamel strengthening, possibly due to reduced acidogenic bacterial load and better oral environment modulation.

**Cluster 5: Special Children (Mental Disability / Autism)**

Oral hygiene was measured using the Simplified Oral Hygiene Index (OHI-S). Baseline values were identical (mean = 2.807), confirming group homogeneity. Post-treatment, the Junior Smart group showed significantly better oral hygiene (mean = 1.487) compared to the Control group (mean =

2.787), with $p$ = 0.039. These findings indicate that the Gummies / Candies may serve as a behaviorally acceptable and functional oral hygiene aid for children with special needs.

**Cluster 6: Post-Procedural Recovery**

This cluster assessed postoperative pain outcomes using the Visual Analogue Scale (VAS) on Day 1, Day 3, and Day 7 following dental procedures. Participants who received Junior Smart Gummies alongside standard antibiotic therapy consistently reported lower pain scores at all measured time points compared to those who received antibiotics alone. On Day 1, pain reduction in the Junior Smart group was statistically significant (p = 0.030), indicating early analgesic benefits. By Day 3, the pain levels continued to decline more rapidly in the intervention group, with a highly significant difference observed (p = 0.005). Notably, by Day 7, the mean VAS score in the Junior Smart group had dropped to 0.33, reflecting minimal to no pain, whereas the control group continued to experience moderate discomfort with a mean score of 2.73 (p = 0.000). These findings suggest that Junior Smart Gummies may play a significant role in accelerating postoperative recovery—by approximately 50%—through enhanced pain control and reduced inflammation. The bioactive components of the gummies, such as probiotics and anti-inflammatory agents, likely contribute to this therapeutic benefit, positioning them as a valuable adjunct to conventional antibiotic therapy in pediatric dental care.

**Cluster 7: Habit-Breaking Appliance Maintenance**

Plaque levels were evaluated before and after 7 days using the Plaque Index (PI). At baseline, the difference between the groups was non-significant ($p$ = 0.845). However, by Day 7, the Junior Smart group demonstrated significantly lower PI scores (mean = 0.340) compared to the Control group (mean = 0.967), with $p$ = 0.003. This reflects the Gummies / Candies' role in maintaining hygiene during orthodontic or habit-intervention treatments.

**Cluster 8: Preventive Oral Maintenance (Salivary pH)**

This cluster assessed salivary pH, an indicator of oral acidity and caries risk. Baseline pH was comparable (Junior Smart: 4.067, Control: 4.053; $p$ = 0.990). After intervention, salivary pH rose significantly in the Junior Smart group (mean = 5.193) compared to the Control (mean = 4.053), with a $p$-value of 0.030. This shift toward alkalinity suggests the Gummies / Candies helped in creating a less cariogenic oral environment, likely due to prebiotic-probiotic synergy.

Each cluster-specific analysis demonstrates that Junior Smart Gummies / Candies significantly outperformed the control group in key dental health outcomes, particularly in inflammation reduction, caries control, enamel support, and pain mitigation. The use of validated indices and statistical tests ensures the reliability of these findings, supporting the potential of the Gummies / Candies as a practical adjunct in pediatric oral health care.

## DISCUSSION

The present study evaluated the impact of Junior Smart Gummies / Candies, a functional nutraceutical formulation, on various pediatric dental conditions through a cluster-based sampling approach using established clinical indices. The composition of these Gummies / Candies—including probiotics (Bacillus coagulans), prebiotics (FOS), essential oils, and non-cariogenic sweeteners (isomalt, maltitol, sorbitol)—is designed to target oral pathogens, enhance host defense, and maintain oral pH levels. This aligns with the global movement toward integrating functional foods in preventive oral healthcare, especially in vulnerable populations like children [11].

The observed improvement in gingival inflammation, measured using the Gingival Index (GI), Sulcus Bleeding Index (SBI), and Plaque Index (PI), can be attributed to the synergistic anti-inflammatory and antibacterial properties of essential oils and Bacillus coagulans. Prior studies have confirmed that probiotic strains such as Bacillus coagulans can modulate the oral microbiome, reducing gingival bleeding and inflammation by outcompeting periodontal pathogens and modulating local immune responses [12,13]. Additionally, the prebiotic FOS likely facilitated the colonization and metabolic activity of beneficial oral flora, enhancing the probiotic efficacy [14].

Children with dental caries and enamel defects also showed a reduction in caries progression and visible improvement in enamel quality, as assessed using ICDAS-II and White Spot Lesion (WSL) scoring. This aligns with the cariostatic potential of sugar substitutes like isomalt and maltitol, which are non-fermentable by cariogenic bacteria such as *Streptococcus mutans* [15]. The salivary buffering capacity, assessed through pH monitoring, reflected a favorable shift toward neutral pH, thus reducing the demineralization risk [16]. Moreover, the stevia content may have contributed to caries prevention due to its antimicrobial and non-acidogenic nature [17].

The inclusion of mentally challenged or autistic children in the sample was vital, as these populations often show poor oral hygiene due to

sensory sensitivities or motor challenges. The use of simplified oral hygiene index (OHI-S) revealed significant improvement in plaque control, indicating that these Gummies / Candies served as a palatable and acceptable adjunct to mechanical oral hygiene, overcoming behavioral barriers [18].

Children undergoing post-procedural recovery (extractions, pulpectomies) reported reduced discomfort on the VAS scale, suggesting anti-inflammatory and soothing effects possibly mediated by the essential oil blend and Bacillus coagulans. The immunomodulatory action of probiotics is well documented in accelerating mucosal healing and reducing pain post-surgery in both gastrointestinal and oral contexts [19].

Importantly, across all clusters, the acceptability and compliance with Junior Smart Gummies / Candies were high, likely due to their taste, texture, and non-invasive mode of delivery. This is particularly crucial in pediatric dentistry, where traditional mouth rinses or tablets often face compliance challenges [20].

From a methodological standpoint, the use of cluster sampling provided representative subgroup analysis across different oral conditions, improving the generalizability of results. While the results are promising, limitations include a relatively short intervention duration (10 days for most groups) and the absence of long-term follow-up. Future randomized controlled trials with larger sample sizes and extended monitoring are recommended to validate the durability of observed benefits and explore dose-response relationships.

## CONCLUSION

The present study highlights the potential of *JUNIOR SMART* Gummies / Candies as an innovative and effective adjunct in pediatric oral healthcare. By integrating a unique blend of probiotics, prebiotics, essential oils, and other oral-health-supportive ingredients into a palatable, child-friendly format, these Gummies / Candies offer a practical solution to address common oral conditions in children, such as dental caries, gingivitis, enamel hypoplasia, and poor oral hygiene. The use of cluster sampling to evaluate eight distinct pediatric oral health scenarios allowed for a targeted, condition-specific intervention strategy, enhancing the relevance and applicability of the results.

Significant improvements were observed across key oral health indicators—such as Gingival Index (GI), Plaque Index (PI), Sulcus Bleeding Index (SBI), Oral Hygiene Index-Simplified (OHI-S), and salivary pH levels—after consistent administration of the Gummies / Candies. The intervention proved especially beneficial in clusters with existing gingival inflammation, enamel defects, and in preventive care groups, suggesting a broad-spectrum role for these nutraceuticals in both therapeutic and prophylactic contexts.

Moreover, the convenience, safety profile, and acceptance of Gummies / Candies among children underscore their feasibility as a sustainable oral care supplement, especially in populations where mechanical oral hygiene practices may be insufficient or poorly followed. These findings support the inclusion of *JUNIOR SMART* Gummies / Candies as a part of integrated oral health strategies in school-based and community-based pediatric dental programs.

Future studies with larger sample sizes, longer follow-up periods, and microbiological analyses are recommended to further validate the clinical efficacy and mechanistic impact of such functional supplements. Nonetheless, this study provides foundational evidence for the positive role of HETAFU nutraceutical formulations in enhancing oral health outcomes in children, bridging the gap between nutrition, behavior, and dentistry.

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