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Original Article

The Role of Green Banana in The Dietary Management of Children with Diarrhea: A Systematic Review and Meta Analysis

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Abstract:

Background: Diarrheal disease is a leading cause of morbidity and mortality among children under five, particularly in developing countries. Green bananas have shown therapeutic potential in managing pediatric diarrhea. This systematic review and meta-analysis compared the effectiveness of green banana supplementation versus non-green banana dietary management in children with diarrhea, alongside the use of ORS (oral rehydration solution) and Zinc. Outcomes assessed were recovery days, dehydration status, and progression to persistent diarrhea.

Methods: A systematic search was conducted across PubMed, Cochrane, Scopus, and ProQuest databases, following the PRISMA guidelines. Qualitative analysis was assessed using the RoB 2.0. Quantitative analysis was performed using RevMan 5.4 with forest plot visualization.

Result: From 57 identified studies, eight were included for review (seven randomized controlled trials and one pilot study). Among 1,486 children receiving green bananas, 1,370 recovered from diarrhea within seven days. Meta analysis showed significantly improved diarrheal recovery with green banana on day 3 (OR 3.41, 95% CI: 2.93-3.98, P<0.00001), day 5 (OR 3.48, 95% CI: 2.15-5.62, P<0.00001), and day 7 (OR 2.86, 95% CI: 2.14-3.82, P<0.00001). Green banana supplementation also showed less frequent dehydration (OR 0.38, 95% CI: 0.16-0.92, P=0.03) and reduced the progression to persistent diarrhea (OR 0.29, 95% CI: 0.21-0.39, P<0.00001).

Conclusion: Green banana with high pectin and amylose-resistant starch (ARS), is an effective dietary adjunct in the management of pediatric diarrhea, in terms of improving recovery, reducing dehydration, and preventing prolonged diarrhea in children due to their antimicrobial and anti-inflammatory compounds.

Keyword: children, dehydration, diarrhea, green banana, pediatric

Introduction

Diarrheal disease remains as one of the major causes of morbidity and mortality, particularly among children in developing countries. Diarrheal affecting children under five years old for 63% of global diarrheal burden. In developing countries, diarrhea is the second major cause of infant mortality as sanitation and clean water supply are poor. In South America, Asia, and Africa, diarrhea can affect one out of eight deaths in Children under 5 years per year.[1-3]

The management of pediatric diarrhea depends on its severity and underlying etiology, with antibiotics being reserved only for specific cases. Generally, the standard treatment of diarrhea primarily focuses on preventing dehydration and maintaining intestinal health. The treatment includes oral rehydration solution (ORS), continued oral feeding or nutritional support, zinc supplementation, and anti-infective agents. Zinc is routinely given to children in areas with a high risk of malnutrition, as it has been proven to effectively reduce the duration and severity of diarrheal episodes.[4, 5]

Green banana has nutritional and physiological benefits for human, as they are rich in dietary fibers, minerals (such as zinc, magnesium, potassium, phosphorus, and potassium), vitamins (such as Vit C, B6, and provitamin A), phenolic compounds, and resistant starch. Since the ancient times, green banana has been utilized as a traditional home remedy in the Indian subcontinent, its anti-diarrheal properties are attributed to the production of short-chain fatty acids (SCFA) in the colon from its amylase-resistant starch content, which enhances colonic water and electrolyte absorption.[6]

In many communities, unripe green banana has traditionally been used in the treatment of intestinal disorders, including diarrhea.[7, 8] Rabbani et al. showed that green banana (Musa paradisiaca) supplementation combined with a rice-based diet accelerated recovery from persistent diarrhea, while more recent studies by Sarmin, supported its potential therapeutic role.[7, 8] However, the available evidence remains inconclusive, as most studies were conducted with relatively small sample sizes, limited settings, and heterogeneous methodologies.[7] Therefore, the potential therapeutic role of green banana in diarrheal cases, as well as the uncertainties surrounding its use, still warrants further investigation.

To our knowledge, no previous systematic reviews have studied the role green banana in the dietary management of children with diarrhea. Thus, this systematic review and meta-analysis aims to identify and evaluate the role of green banana as a dietary management of children under five years old with diarrhea, specifically assessing its impact on recovery duration, dehydration status, and prevention of progression to persistent diarrhea.

Method

Search Strategy

This systematic review has been registered in PROSPERO with registration number CRD420251125670. A systematic search was conducted across four databases (PubMed, Cochrane, Scopus, and ProQuest), according to the PRISMA guidelines. The search strategy was structured based on the Population, Intervention, Comparison, and Outcome (PICO) framework. The population for this study was pediatric patients under five years of age diagnosed with diarrhea. The intervention group was patients receiving green banana supplementation as part of their diarrheal management, while the comparison or control group was patients receiving only standard care, such as ORS and zinc supplementation. Primary outcomes assessed were recovery duration, dehydration status, and progression to persistent diarrhea. Search terms used are listed in **Table 1.**

Table 1. Search strategy.

Databases/ Registers	Keywords
PubMed	((((Children) OR (paediatric)) OR (Gastroenteritis)) AND ((Green banana) OR (Musa paradisiaca))) AND ((((Diarrhea) OR (Gastroenteritis)) OR (Dysentery)) OR (Enteritis)).
Cochrane	Children in Title Abstract Keyword AND diarrhea in Title Abstract Keyword AND green banana in Title Abstract Keyword
Scopus	((((Children) OR (paediatric)) OR (Gastroenteritis)) AND ((Green banana) OR (Musa paradisiaca))) AND ((((Diarrhea) OR (Gastroenteritis)) OR (Dysentery)) OR (Enteritis))
Proquest	abstract(Children) AND abstract(Diarrhea) AND abstract(green banana)

Study Selection and Eligibility Criteria

Inclusion criteria were: (1) children under 18 years of age diagnosed with diarrhea, (2) intervention group received green banana and control group received standard care for diarrhea, (3) outcomes were recovery days from diarrhea, dehydration status, and the progression to persistent diarrhea, (4) papers published in English with full-text availability. Exclusion criteria were as follows: (1) absence of recovery days, (2) unavailable full texts. Duplicate studies were removed using EndNote Software.

Heterogeneity among study results was assessed using the I^2 statistic and visually inspected in forest plots. Meta-regression was not conducted because the number of eligible studies was too limited to provide reliable estimates.

Data Collection

Four independent reviewers screened titles and abstracts across the four databases, followed by full-text reviews to ensure eligibility. No automation tools were used in the screening or data extraction process as all steps were conducted manually by the reviewers.

The extracted data includes study characteristics (author, location, study design, year of publication, sample size, population criteria, mean age, duration of diarrhea, body weight) and outcomes (recovery days, dehydration status, and progression to persistent diarrhea) for both intervention and control groups. To ensure comparability, outcomes were extracted only if they were explicitly defined and reported across studies. When differences in definitions or measurement methods were identified, the reviewers discussed them and reached consensus on whether the data were compatible for inclusion.

Quality Assessment

The tools used for the assessment of the studies were based on the study design. Risk of Bias was evaluated using the Cochrane Risk of Bias 2 (RoB 2.0) tool, consisting of five domains: (1) randomization process, (2) bias due to deviations from intended interventions, (3) missing outcome data, (4) measurement of the outcome, and (5) selection of the reported results. The studies were scored as low risk, high risk, or some concerns. Visualization of the bias was generated by the ROBVIS tool, generating traffic-light and weighted bar plots. The studies were then appraised as included and excluded. In addition, the risk of bias due to missing results in the synthesis (such as reporting bias) was assessed qualitatively and considered during the interpretation of the results.

Statistical Analysis

The outcomes were categorized into three groups: (1) recovery days of diarrhea (assessed at day 3, 5, dan 7), (2) dehydration status, and (3) progression to persistent diarrhea. All data were analyzed using the RevMan 5.4 software. Since all the outcomes in this review were dichotomous, we used the odds ratio (OR) with 95% confidence intervals (CI) as the effect measure. Inverse variance was employed as a statistical technique utilizing a fixed effect model, with the mean difference serving as the effect measure for data analysis. The 95% confidence interval and heterogeneity were assessed and displayed in the forest plot.

Result

Study Selection

Through the four databases (PubMed, Cochrane, Scopus, and Proquest), a total of 57 studies were obtained from the initial search. After removing duplicates, 35 studies were screened, and 18 were excluded based on the title and abstract review due to inappropriate intervention or ineligible study design. In addition, 3 articles were not retrieved because the full text was unavailable. Fourteen full-text articles were assessed for eligibility, of which six were excluded: 2 did not meet the PICO criteria, 2 was an editorial comment, 1 was only a protocol, and 1 was a literature review. Ultimately, 8 studies (7 randomized controlled trials and 1 pilot study) met the inclusion criteria and were included in this review and meta-analysis. The study selection process is illustrated in **Figure 1.**

Study Characteristics

Seven RCTs and one pilot study were included in this review, comprising 3,778 children with an overall age of under five years.[7-14] The majority of these studies were in Bangladesh, South Asia, with one study (Acosta et al.) from Venezuela.[9] Authors included all classifications of diarrhea: three focused on acute diarrhea, four on persistent diarrhea, and one on both acute and prolonged diarrhea. Detailed study characteristics, including sample size, body weight, and mean age, are summarized in **Table 2.**

Table 2. Included studies characteristics.

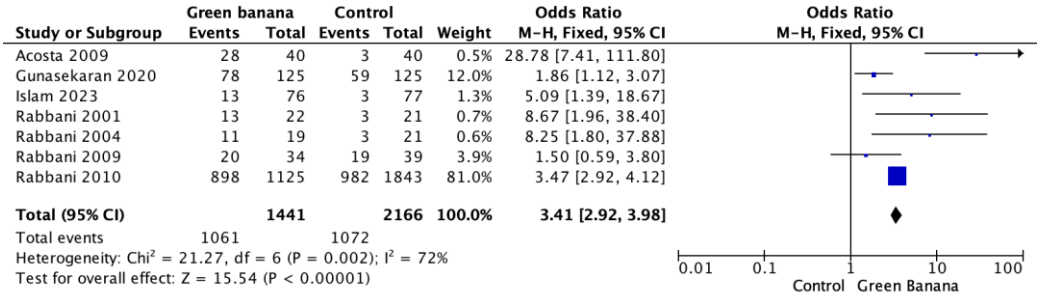
Author, Location	Study Population	Study Design	Samples included	Classification of Diarrhea	Body Weight kg (mean ± SD)		Age in months	
					Green Banana or Pectin	Control	Green Banana or Pectin	Control
Rabbani et al, 2001[7] Bangladesh	Boys, ages between 5 to 12 months	RCT	62	Persistent	Green banana: 6.5 ± 1.8 Pectin: 6.7 ± 1.2	6.8 ± 2.3	Green banana: 8.25 ± 2.9 Pectin: 8.75 ± 3.1	9.1 ± 2.5
Rabbani et al, 2004[8] Bangladesh	Boys, ages between 5 and 12 months	RCT	57	Persistent	Green banana: 7.0 ± 2.2 Pectin: 6.9 ± 1.9	7.1 ± 2.0	Green banana: 8.61 ± 2.0	8.9 ± 2.1

							Pectin: 9.1 ± 2.1	
Acosta et al, 2009[9] Venezuela	Children, ages between from 1-28 months	RCT	80	Persistent	6.0 ±1.6	6.3 ± 1.7	8.8 ± 5.0	Yoghurt -based: 9.5 ± 4.6
Rabbani et al, 2009[10] Bangladesh	Children, age between 6 to 60 months	RCT	73	Acute	8.6 ± 1.7	7.5 ± 1.4	17.4 ± 9.8	16.3 ± 6.5
Rabbani et al, 2010[11] Bangladesh	Children, ages between 6–36 months	RCT	2968	Acute & Prolonged	Acute: 8.4 ± 2.8 Prolonged: 8.0 ± 1.5	Acute: 8.2 ± 2.7 Prolonged: 7.8 ± 1.6	Acute = 18.4 ± 8.8 Prolonged = 17.5 ± 8.5	Acute = 18.7 ± 8.5 Prolonged = 7
Gunasekaran et al, 2020[12] Bangladesh	Children, ages between from 9 months to 5 years	RCT	250	Acute	N/A	N/A	23 ± 13.7	22.8 ±3
Islam et al, 2023[13] Bengal	Children, ages between 6 and 60 months	Pilot study	153	Acute	N/A	N/A	32.4 ± 4.8	34.8 ± 3.6
Sarmin et al, 2023[14] Bangladesh	Children, ages between 6-36 months	RCT	135	Persistent	N/A	N/A	median age: 8 months, interquartile 7-10 months	N/A

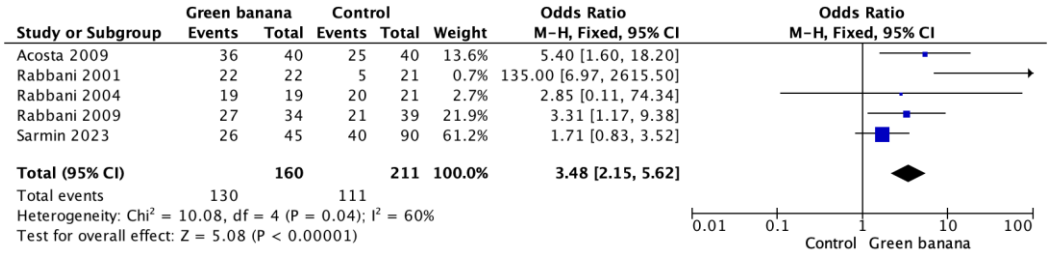
Data synthesis

a.) Recovery days of diarrhea

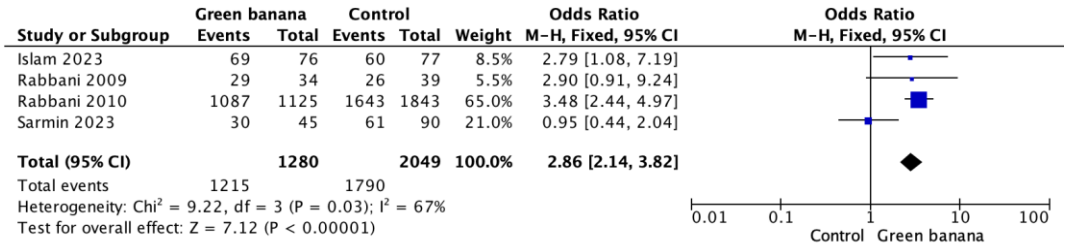
Across eight studies, 1,370 out of 1,486 children receiving green banana supplementation recovered from diarrhea within seven days. Meta-analysis showed significant improvement in recovery rates in children receiving green banana at day 3 (OR 3.41, 95% CI: 2.93-3.98, P<0.00001), day 5 (OR 3.48, 95% CI: 2.15-5.62, P<0.00001), and day 7 (OR 2.86, 95% CI: 2.14-3.82, P<0.00001). These results indicate that green bananas significantly accelerate the recovery from diarrhea **(Figure 2).**



a.) Forest plot for recovery day 3.



b.) Forest plot for recovery day 5.



c.) Forest plot for recovery day 7.

Figure 2(a-c). Forest plot for the recovery day of diarrhea.

b.) Dehydration status of diarrhea

Two studies assessed the dehydration status of diarrhea. Gunasekaran et al. reported that 2 out of 125 patients had dehydration in the green banana group, indicating that green banana can reduce dehydration (OR 0.14, 95% CI: 0.03 - 0.63), whereas Rabbani et al., found no significant association (OR 1.03, 95% CI: 0.29-3.62) between green banana consumption and dehydration status.[12, 13] The pooled analysis indicated a significant reduction in dehydration risk with the supplementation of green banana (OR 0.38, 95% CI: 0.16-0.92, P=0.03) **(Figure 3).**

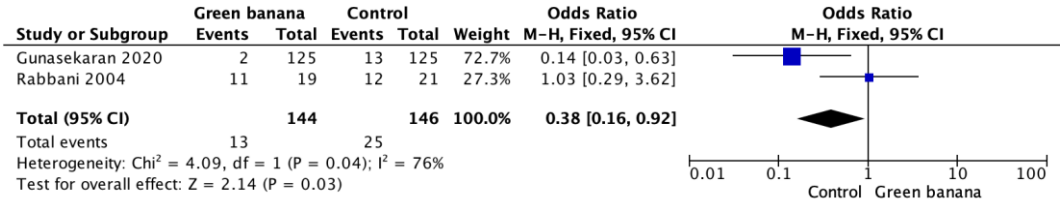


Figure 3. Forest plot for the dehydration status of diarrhea.

c.) Progression to persistent diarrhea

There were four out of eight studies that classified diarrhea as acute diarrhea, with three of them mentioning the progression from acute to persistent diarrhea (Gunasekaran et al., Islam et al., and Rabbani et al).[11,12,13] The meta-analysis showed that green banana significantly reduced the risk of progression from acute to persistent diarrhea (OR 0.29, 95% CI: 0.21-0.39, P<0.00001) **(Figure 4)**.

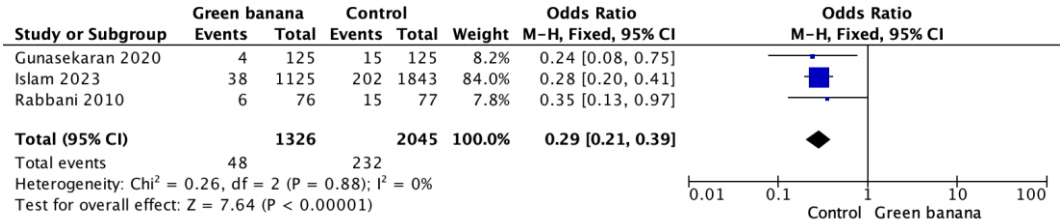


Figure 4. Forest plot for the progression to persistent diarrhea.

Risk of Bias

Our comprehensive risk of bias assessment for this meta-analysis revealed consistently strong methodological quality across the included studies. All 8 studies demonstrated predominantly low risk of bias across the five critical domains examined using the RoB 2.0 tool.

While minor methodological variations were noted in individual studies, particularly in Rabbani et al.[7] regarding selective reporting and in Rabbani et al.[12] concerning aspects of the randomization process, these variations did not compromise the overall methodological soundness of the research.

However, we acknowledge that such methodological variations may have contributed to some degree of heterogeneity observed in the pooled results. Despite these variations, we concluded that the body of evidence compiled for this meta-analysis rests on a foundation of methodologically sound research, with all studies meeting our predetermined criteria for inclusion. This enhances our confidence in the pooled results and strengthens the reliability of the findings of our study **(Figure 5).**

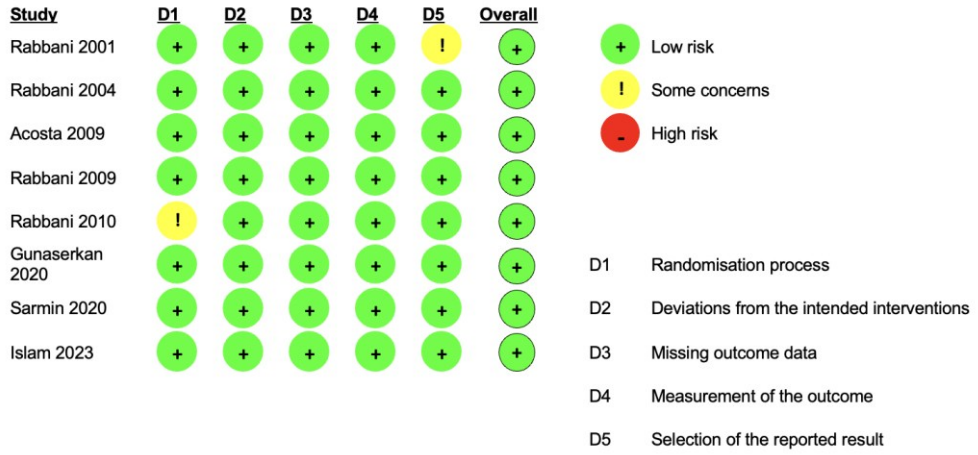


Figure 5. Risk of Bias.

Discussion

This meta-analysis demonstrates that green banana supplementation significantly improves diarrheal recovery outcomes in children under five years of age. Evidence in this paper shows substantial benefits across multiple outcomes, particularly in reducing recovery time.[15, 16]

Our analysis revealed that children receiving green banana were significantly more likely to recover from diarrhea by day 3 (OR 3.41, 95% CI: 2.93-3.98, P<0.00001), day 5 (OR 3.48, 95% CI: 2.15-5.62, P<0.00001), and day 7 (OR 2.86, 95% CI: 2.14-3.82, P<0.00001) compared to controls. This consistent pattern of improvement across different time points strengthens the evidence for green banana's therapeutic efficacy. The high recovery rate in the intervention group (1,370 out of 1,486 children) further supports this conclusion.[11, 12]

In addition, green banana supplementation also showed benefits in reducing dehydration, a critical complication which contributes to morbidity and mortality in children.[17] The pooled analysis of dehydration status (OR 0.38, 95% CI: 0.16-0.92, P=0.03) indicates that children receiving green bananas were less likely to experience dehydration, though it should be noted that only two studies assessed this outcome with somewhat conflicting results.[7, 13] While Gunasekaran et al.[13] found a significant reduction in dehydration (OR 0.14, 95% CI: 0.03-0.63), Rabbani et al.[9] found no

significant association (OR 1.03, 95% CI: 0.29-3.62).[9-12] This discrepancy warrants further investigation in future studies.

Perhaps most notably, it is shown in this paper that green banana supplementation significantly reduced the risk of acute diarrhea progressing to persistent diarrhea (OR 0.29, 95% CI: 0.21-0.39, P<0.00001).[12-14] This finding is particularly important in clinical practice, as persistent diarrhea is associated with increased risk of malnutrition, growth faltering, and mortality in children.[17]

The geographically confined nature of seven out of eight studies to Bangladesh also means it is doubtful if the effects are generalizable to other groups of people who eat differently, have different gut microbiota patterns, and exposure environments.[14]s[8] Even that single study carried out in Venezuela by Alvarez-Acosta et al., reported the same favorable impacts, meaning green banana may work in non-South Asian populations, but this needs further evidence in different settings.[10]

Most of the studies recruited male children or did not report gender distribution, which might limit the ability to generalize outcomes across genders.[7-14] The studies further covered various categories of diarrheal duration (acute, prolonged, and persistent), indicating green banana can be beneficial in a range of diarrheal manifestations, but possibly through different mechanisms.[12]

The literature indicates a number of possible mechanisms by which green banana exerts its anti-diarrheal action.[6] Green bananas are a source of resistant starch, which can function as a prebiotic, stimulating the growth of beneficial gut flora and increasing the production of short-chain fatty acids.[18] These fatty acids, especially butyrate, play a key role in colonic health and water absorption.[19] Green bananas also have bioactive compounds with possible antimicrobial and anti-inflammatory activities that could restore gut homeostasis.[20]

While our findings are strongly indicative of the therapeutic potential of green banana in pediatric diarrhea, several limitations need to be acknowledged. The studies varied in reporting such essential variables as body weight and precise age, which affect dosing recommendations. Further, data on the preparation, administration, and dosage of green banana varied between studies, preventing the identification of optimal treatment regimens.[7-14]

Further research should also seek to standardize the preparation of green banana, determine dose-response approaches on a relative basis of age and weight, examine potential synergisms with other drugs, and elucidate the resulting specific biochemical foundation for the derived clinical effects. They should also be conducted in other regions to determine if the results have generalizability.

In conclusion, the present meta-analysis offers strong evidence that green banana supplementation is useful in recovery from diarrhea, avoids risk of dehydration, and prevents advancement to chronic diarrhea in children under five years. Due to its efficacy, accessibility, and low cost, green banana is a promising adjunct therapy for childhood diarrhea, particularly in resource-limited countries where diarrheal disease burden is most relevant.

Limitation of the Study

In this systematic review, studies were mostly conducted in Asian countries, thus not covering many countries from other continents. Further research on green bananas as a therapy for diarrhea in non-Asian countries is needed.

Conclusion

This systematic review and meta-analysis provide compelling evidence that green banana is significantly effective as a dietary supplement in the management of diarrhea among children under five. Across the eight included studies, children who received green banana in addition to standard treatment demonstrated a faster recovery time, reduced risk of dehydration, and a markedly lower likelihood of progressing to persistent diarrhea. These benefits are likely attributable to the high content of pectin, resistant starch, and bioactive compounds in green banana, which enhance colonic absorption, improve gut microbiota, and support intestinal health.

Given its affordability, accessibility, and favorable safety profile, green banana represents a promising adjunct to existing diarrhea management protocols, especially in resource-constrained settings. Nevertheless, variations in study location, sample demographics, and preparation methods warrant further research to establish standardized dosing, optimize treatment regimens, and validate generalizability across diverse populations. In summary, green banana is a practical and effective dietary strategy that should be considered in the comprehensive management of pediatric diarrhea.

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Conflict of Interest

There is no conflict of interest.

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