

An Analysis of pH and Sugar Content of Commonly Prescribed Pediatric Liquid Medications: The Current Indian Scenario

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OBJECTIVES Oral liquid medications are frequently prescribed to children because they are easier to swallow than other dosage forms. These pediatric liquid medications (PLMs) have sugars added to them for better compliance or as preservatives. Children with chronic illnesses may frequently consume these medications. The presence of sugars and their frequent exposure presents a high risk of dental caries in these children. Additionally, the critical pH can be reached if acids below a pH of 5.5 contact the tooth, causing enamel demineralization. Hence, there was a need to study the sugar content and pH of these medications.

METHODS Pediatricians and pharmacists in Vadodara city, Gujarat, India, were given a short questionnaire to assess the most prescribed and sold PLMs for analgesics, antibiotics, antiepileptics, multivitamins, and antitussives in the Indian pharmaceutical market. The sugar content and pH of the 15 most prescribed PLMs were assessed with ultraviolet/visible (UV/VIS) spectrophotometry and digital pH meter, respectively. Descriptive statistics were used to analyze the data.

RESULTS Only 1 of the 15 most sold/prescribed medicines did not contain sugar. Among the remaining PLMs, the sugar concentration ranged from 6.1% to 78.7%. The pH of the PLM ranged from 3.6 to 7.3.

CONCLUSION Sugar was present in 93.3% of the 15 analyzed PLMs and the pH was lower than the critical pH in 80% of them. Medications with high sugar content and low pH can cause caries development. Sugar-free PLMs are preferred alternatives.

ABBREVIATIONS GIDC, Gujarat Industrial Development Corporation; PLM, pediatric liquid oral medication; UV/VIS, ultraviolet/visible

KEYWORDS cariogenic agents; child; dental care for children; pediatric liquid medications; sugars

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Introduction

The field of preventive dentistry has made a significant impact on the prevalence of oral diseases worldwide in the past decades. However, owing to its multifactorial nature, caries persist as one of the most common oral diseases in childhood. The overall worldwide prevalence of dental caries in primary and permanent teeth in children was found to be 46.2% and 53.8%, respectively.¹ Overall, 50% of children have 1 or more decayed primary teeth by the end of toddler age, but the importance of these teeth should not be overlooked.^{2,3} Having healthy teeth in childhood has an important role in the eruption of healthy permanent teeth, healthy nutrition, and one's esthetic appearance.

Young and chronically ill children receive a variety of oral liquid medications on a routine basis.⁴ Parents also administer over-the-counter medications to their children for repetitive illnesses. The biggest challenge for pharmaceutical companies is to make the medicine

palatable to children in order to improve compliance.⁵ Manufacturers overcome this challenge by adding sugars to oral liquid medications. These sweetening agents are added to mask the unpleasant taste of the active ingredients. Although parents have become vigilant about the role of sugars in childhood obesity and dental caries, they are often unaware of the hidden, added sugars in many foods and drinks including pediatric liquid medications (PLMs).⁶

Additionally, these PLMs often have low pH. Both the presence of sugars and low pH are known risk factors for development of dental caries. The critical pH is the pH at which a solution is just saturated with respect to a particular mineral, such as tooth enamel. The critical pH, below which the enamel demineralizes, is 5.5. It plays an important role in the carious and erosive progressions in teeth.

A review of the past scientific literature confirms the role of PLMs in dental caries and dental erosion.^{7–10} This

makes the use of sugar-containing PLMs a risk to the dental and overall health of children especially those suffering from chronic illnesses. In spite of adequate alternatives to medicines sweetened with sugar, their substitution has been slow.¹¹ This prompted a need to evaluate the current scenario in prescription and consumption of PLMs and to analyze the sugar content and pH of commonly prescribed PLMs in Indian markets.

Methods

This study was carried out in 2 phases. In the first phase, pediatricians and pharmacists from Vadodara city, Gujarat, India, were given a short questionnaire (see Table 1) to assess the most prescribed and sold pediatric liquid oral medications, respectively.

The study sample was selected as follows: 1) All the pediatricians present during the 2 consecutive monthly meetings for the Academy of Pediatrics, Vadodara and willing to participate were included in the study; and 2) The list of pharmacies in Vadodara city was obtained from the yellow pages. Only qualified pharmacists and those willing to participate were included in the study.

Both groups were asked to mention any 2 most commonly prescribed/dispensed PLMs each for analgesics, antibiotics, antiepileptics, multivitamins, and antitussives. Pediatricians and pharmacists could list generic or the brand names in the survey (Table 1). Descriptive statistics were used to find the 3 most prescribed medications in each category.

In the second phase of the study, the list of the 15 most prescribed/sold medicines (3 in each group) was obtained from the results of the above survey. The PLMs were given an alpha-numerical code. The numbers were allotted as per the category of the drug in each category followed by an alphabetical code—A, B, and C—randomly. The 15 PLMs were coded 1A, 1B, 1C, 2A,

2B, 2C, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, and 5C. The randomization in coding within each category ensured anonymity and prevented bias. All the 15 short-listed PLMs were purchased from the local pharmacies. The sugar content and pH of these 15 most prescribed PLMs were assessed.

The determination of sugar content vis-à-vis sucrose was carried out in the 15 most prescribed/sold commercial and generic medicines, using ultraviolet/visible (UV/VIS) spectrophotometry at Research and Development, Vasu Research Centre, Gujarat Industrial Development Corporation (GIDC), Makarpura, India. The procedure for sample preparation and analysis is detailed in the Supplemental Table.

The pH of PLMs was also measured at Vasu Research Centre, using a digital pH meter. The pH electrode was cleaned with distilled water. Twenty milliliters of each PLM was taken in a glass beaker and placed in a thermostatically controlled water bath at 37°C and a glass electrode was inserted into the liquid, which displayed the pH on the meter. Each sample was tested 3 times to record a mean measurement. Descriptive statistics were used to analyze the data.

Results

The number of pharmacists and pediatricians who participated in the study by responding to the questionnaire was 102 and 54, respectively. The response rate for this questionnaire survey for the pharmacists and pediatricians was 82.3% and 88.5%, respectively. Two forms from the pharmacists and 1 from pediatricians study population were incompletely filled. Only those questionnaires that were completely filled out were included in this study (n = 156).

The data obtained were coded and analyzed. The 3 most frequently prescribed/sold PLMs for analgesics,

Table 1. Study Pro Forma for Pediatricians and Pharmacists

1. For pediatricians

Please mention 2 liquid medications you most frequently prescribe for the following categories in pediatric patients.
[Please mention brand names.]

i. Analgesics

1. 2.

ii. Antibiotics

1. 2.

iii. Antiepileptics

1. 2.

iv. Multivitamins

1. 2.

v. Antitussives

1. 2.

(To prevent cough)

2. For pharmacists

Please mention 2 liquid medications you frequently dispense for the following categories in pediatric patients.
[Please mention brand names.]

i. Analgesics

1. 2.

ii. Antibiotics

1. 2.

iii. Antiepileptics

1. 2.

iv. Multivitamins

1. 2.

v. Antitussives

1. 2.

(To prevent cough)

antibiotics, antiepileptics, multivitamins, and antitussives were determined and tested. The PLMs most frequently prescribed/sold in each category are listed in Table 2.

The sugar content analysis was carried out for the 15 most prescribed/sold commercial and generic medicines, using UV/VIS spectrophotometry. The pH was also measured (Table 3). The concentrations of the antibiotics are in 10% water, as the original products were in powdered form.

The results showed that among the 15 most sold/prescribed medicines only 1 did not contain any sugar (antibiotics), while the remaining 93.3% of the tested

PLMs had a sugar concentration ranging from 6.1% to 78.7%.

The pH of the 15 tested PLM ranged from 3.6 to 7.3. Twelve of the 15 PLMs (80%) had pH lower than the critical pH for dental demineralization (<5.5).

Discussion

The scientific discourse on the sugar content of PLMs has been an ongoing issue for the past 2 decades but there is no consensus or legislation regarding it. The role of frequent use of PLMs and their cariogenic potential is well established.^{7–10} This study aimed to evaluate

Table 2. Most Frequently Prescribed/Sold Pediatric Liquid Medications According to Categories

Code	Category	Drugs Brand Names (Generic Name)	Manufacturers
1	Analgesics	Ibugesic Plus Oral Suspension (ibuprofen and paracetamol)	Cipla Ltd (Mumbai, Maharashtra)
		Calpol Paediatric Syrup (paracetamol)	GSK Pharmaceuticals Ltd (Mumbai, Maharashtra)
		Flexon Syrup (ibuprofen and paracetamol)	Aristo Pharmaceuticals Ltd (Mumbai, Maharashtra)
2	Antibiotics	Augmentin Duo Oral Suspension (amoxicillin + clavulanic acid)	GSK Pharmaceuticals Ltd (Mumbai, Maharashtra)
		Zifi Syrup (cefixime)	FDC Ltd (Ahmedabad, Gujarat)
		Azithral Syrup (azithromycin)	Alembic Pharmaceuticals (Vadodara, Gujarat)
3	Antiepileptics	Tegrital Syrup (carbamazepine)	Novartis India Ltd (Mumbai, Maharashtra)
		Valprol Syrup (sodium valproate)	Intas Pharmaceuticals Ltd (Ahmedabad, Gujarat)
		Levipil Syrup (levetiracetam)	Sun Pharmaceuticals Ltd (Ahmedabad, Gujarat)
4	Multivitamins	A to Z NS Syrup (multivitamin and multimineral)	Alkem Laboratories Ltd (Mumbai, Maharashtra)
		Bevon Suspension (multivitamin and multimineral)	Zuventus Healthcare Ltd (Mumbai, Maharashtra)
		Zincovit Syrup (multivitamin and multimineral)	Apex Laboratories Ltd (Chennai, Tamil Nadu)
5	Antitussives	Alex Syrup (phenylephrine, chlorpheniramine maleate, and dextromethorphan hydrobromide)	Glenmark Pharmaceuticals (Mumbai, Maharashtra)
		Wikoryl Oral Suspension (phenylephrine, chlorpheniramine maleate, and paracetamol)	Alembic Pharmaceuticals Ltd (Vadodara, Gujarat)
		Chericof Syrup (phenylephrine, chlorpheniramine maleate, and dextromethorphan hydrobromide)	Sun Pharmaceuticals Ltd (Ahmedabad, Gujarat)

Table 3. Sugar Content and pH of Commonly Prescribed and Sold PLMs

SR No.	Sample Code	pH	Total Sugar by UV, %
1	1A	5.3	54.1
2	1B	5.5	48
3	1C	6.	62.5
4	2A	4.1 (10% solution)	6.1
5	2B	3.6 (10% solution)	0
6	2C	5.5 (10% solution)	6.7
7	3A	7.3	59.5
8	3B	5.3	78.7
9	3C	3.8	53.4
10	4A	3.8	52.6
11	4B	4.2	64.9
12	4C	3.9	51.1
13	5A	5	70.1
14	5B	5.1	58.6
15	5C	4.4	53.5

PLMs, pediatric liquid medications; SR no, serial number UV, ultraviolet

the current scenario for sugar content and pH of most prescribed PLMs in Indian markets.

In this study, only 1 of the 15 PLMs did not contain sugar, whereas the study conducted by Peres et al¹¹ reported that 4 of 14 sold/prescribed medicines (analgesic, cortisone, and 2 bronchodilators) sold in Tubarão, Southern Brazil, did not contain sugar. These results show the presence of sugars in most prescribed PLMs. This finding is important to create awareness among parents, pediatricians, and policymakers to make an informed choice between sugar-containing and sugar-free PLMs. The opinion and lobbying against the policy of promoting sugar-free products makes the reasons for lack of legislation evident.¹² Increased awareness along with more research and funding to find safe, nontoxic, economic, and reliable sugar-free alternatives will make the shift from sugar-containing PLMs to sugar-free alternatives easier.

Similar results regarding low pH, with the majority below the critical pH, were observed in studies by Sunitha et al,¹³ Lima et al,¹⁴ Cavalcanti et al,¹⁵ and Gowdar et al.¹⁶ These results are in contrast to the study conducted by Girish Babu et al¹⁷ where the pH ranged above the critical pH. The pH of the medication may contribute to demineralization of the enamel and to the cariogenic potential of PLMs.

Most children did not brush their teeth after taking drugs.¹⁸ The probability of dental caries is increased in children taking long-term medications, especially if no oral health care instructions are provided. Instructions to rinse teeth with water post consumption of medication and brushing teeth after 30 to 60 minutes can help prevent dental caries.

Conclusion

In this study 14 of the 15 most consumed PLMs manufactured in India that were tested contained sugar. The sugar concentration in this study ranged from 6.1% to 78.7% with high sugar content in analgesics, antiepileptics, multivitamins, and antitussives. The pH of the 15 PLMs in the current study ranged from 3.6 to 7.3. Twelve of the 15 PLMs had pH lower than the critical pH for dental demineralization (<5.5), thus making sugar-free PLMs a necessary alternative. This study suggests there are currently few sugar-free PLMs available in India. Health professionals need to be more vigilant regarding the cariogenic potential of PLMs administered to children with chronic illnesses. Increased awareness of the risks of PLMs with sugar and low pH and promotion of good oral hygiene could reduce the rates of dental caries in these patients. In addition, more research and funding to develop sugar-free PLMs would likely benefit this pediatric population.

Article Information

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