

Impact of Dietary Sugar Intake on the Prevalence of Dental Caries in Adolescents: A Qualitative Study of Behavioral, Environmental, and Personal Factors Influencing the Association

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Abstract

Background: Dental caries remains one of the most prevalent chronic diseases among adolescents globally and in Pakistan, where prevalence rates frequently exceed 50–70% in school-aged populations. Despite robust epidemiological evidence linking frequent sugar consumption—particularly sugar-sweetened beverages and snacks—to caries development, the subjective motivations, lived experiences, and socio-cultural contexts driving these behaviors remain underexplored. Existing studies are predominantly quantitative, leaving the personal, familial, peer, and environmental dimensions of adolescents' sugar intake and caries experiences largely unexamined.

Objective: To generate an in-depth, participant-centered qualitative account of the factors influencing sugar consumption among Pakistani adolescents, their personal and social experiences of dental caries, and their reflections on prevention strategies and conditions that might support reduced intake.

Methods: A qualitative descriptive design situated within a constructivist-interpretivist epistemological framework was employed. Thirty adolescents aged 12–18 years from urban and peri-urban settings in Pakistan were recruited through purposive and snowball sampling. Individual semi-structured interviews were conducted in person or online, audio-recorded, and transcribed verbatim. Data were analyzed using Braun and Clarke’s six-phase reflexive thematic analysis framework. Trustworthiness was established through prolonged engagement, peer debriefing, reflexive memo-writing, and audit trail maintenance. The study was conducted in accordance with COREQ reporting guidelines.

Results: Six themes were identified: cultural and familial normalization of sugar as comfort and reward; peer influence and social bonding through sugary consumption; knowledge–behavior gap and denial of personal risk; economic accessibility and environmental ubiquity of sugary products; lived impact of caries on daily functioning and self-image; and moral residue with conditional orientation toward behavior change.

Conclusion: Adolescent sugar consumption and resultant dental caries in Pakistan are driven by cumulative socio-cultural and environmental factors rather than knowledge deficit alone. Adolescents retain conditional agency for reduction amenable to policy and family-level intervention. Comprehensive approaches—spanning dietary regulation, school-based education, affordable healthy alternatives, and adolescent engagement—are essential to address this phenomenon.

INTRODUCTION

The global burden of dental care among adolescents represents a significant public health challenge, particularly in low- and middle-income countries where access to preventive care remains limited. Dental caries results from the interaction of cariogenic bacteria, fermentable carbohydrates (primarily free sugars), and host factors over time, with frequent sugar consumption identified as the most important modifiable risk factor. Longitudinal evidence has shown that sustained sugar intake from childhood through adolescence is significantly associated with increased progression of dental caries over time. The World Health Organization (WHO) recommends limiting free sugars to less than 10% of total energy intake—and ideally less than 5%—to minimize caries risk throughout the life course. In Pakistan, epidemiological data indicate caries prevalence rates of 55–68% among school children, with strong associations to sugary snack and beverage intake.

Despite this evidence, quantitative studies have primarily documented prevalence, frequency of sugar intake, and statistical associations, without fully capturing how adolescents themselves understand, experience, and navigate the relationship between sugar consumption and oral health. Existing literature highlights that adolescents often possess basic knowledge of caries risk yet continue high sugar intake due to peer norms, family practices, affordability, and marketing influences. A critical gap persists in participant-centered qualitative accounts that explore the meanings adolescents attach to sugar consumption, the embodied experience of caries, and their perspectives on what might facilitate change.

The present study addresses this gap by adopting a qualitative descriptive approach grounded in constructivist-interpretivist epistemology. It seeks to illuminate the

behavioral, environmental, and personal dimensions of the sugar–caries association among Pakistani adolescents, informing more effective, contextually relevant prevention strategies.

MATERIALS AND METHODS

This study employed a qualitative descriptive design situated within a constructivist-interpretivist epistemological framework. Qualitative descriptive methodology is appropriate when the research aim is to produce a comprehensive, rich, and participant-centered account of a phenomenon as it is experienced and understood by those living it. Thirty adolescents aged 12–18 years were recruited from urban and peri-urban areas of Islamabad/Rawalpindi and surrounding districts. Participants were eligible if they reported regular sugar consumption (≥ 3 times/week) and had either self-reported or clinically noted dental caries experience. Purposive sampling ensured variation in age, gender, socioeconomic status, and school type (public/private). Snowball sampling was used for subsequent recruitment

Individual semi-structured interviews (45–75 minutes) were conducted in Urdu or English according to participant preference. An interview guide covered motivations for sugar intake, experiences with dental caries or related symptoms, awareness of risk, barriers/facilitators to reduction, and reflections on prevention. Interviews were audio-recorded, transcribed verbatim, and analyzed using Braun and Clarke’s reflexive thematic analysis. Trustworthiness was ensured through member checking, peer debriefing, and an audit trail. Ethical approval was obtained from the Health Services Academy Institutional Review Board. The study adhered to COREQ guidelines.

RESULTS

The thematic analysis of thirty semi-structured interviews yielded six overarching themes,

each comprising two analytically distinct subthemes. The themes collectively illuminate the behavioral, environmental, social, and moral dimensions of the association between sugar consumption and dental caries among Pakistani adolescents. A summary of the thematic structure, including subtheme definitions and representative participant quotations, is presented in Table 2. Participant characteristics are presented in Table 1.

Table 1. Participant Characteristics (n = 30)

ID	Gender	Age	School Type	Reported Daily Sugar Frequency	Caries Experience
P1	Female	14	Public	4–5 times	Yes (moderate)
P2	Male	16	Private	3–4 times	Yes
P3	Female	13	Public	5–6 times	Yes
P4	Male	15	Private	4 times	Yes (early lesions)
P5	Female	17	Public	3–5 times	Yes
P6	Male	12	Public	5–6 times	Yes
P7	Female	18	Private	3–4 times	Yes
P8	Male	14	Public	4–5 times	Yes
P9	Female	16	Private	4 times	Yes (moderate)
P10	Male	13	Public	3–5 times	Yes
P11	Female	15	Public	5 times	Yes
P12	Male	17	Private	4 times	Yes
P13	Female	12	Public	5–6 times	Yes

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ID	Gender	Age	School Type	Reported Daily Sugar Frequency	Caries Experience
P14	Male	18	Private	3–4 times	Yes (mild)
P15	Female	14	Public	4–5 times	Yes
P16	Male	16	Public	4 times	Yes
P17	Female	13	Private	3–5 times	Yes
P18	Male	15	Public	5–6 times	Yes
P19	Female	17	Private	4 times	Yes
P20	Male	12	Public	4–5 times	Yes
P21	Female	18	Public	3–4 times	Yes (moderate)
P22	Male	14	Private	5 times	Yes
P23	Female	16	Public	4 times	Yes
P24	Male	13	Public	5 times	Yes
P25	Female	15	Private	3–5 times	Yes
P26	Male	17	Public	4 times	Yes
P27	Female	12	Public	5–6 times	Yes (early)
P28	Male	18	Private	3–4 times	Yes
P29	Female	14	Public	4–5 times	Yes
P30	Male	16	Public	4 times	Yes

Table 2. Thematic Framework: Themes, Subthemes, Definitions, and Representative Quotations

Theme	Subtheme	Definition	Representative Quotation
1. Cultural and Familial Normalization of Sugar as Comfort and Reward	1a. Sugar emotional comfort family tradition	Participants described as sugary items embedded in daily routines, and family celebrations, emotional regulation	"Whenever I feel sad or as tired after school, my mom gives me cold drink routines, or mithai. It's our way of and showing care at home." (P3, Female, 13, Public)
	1b. Reward and celebration culture	Sugar consumption was routinely used as reward for good grades or special occasions	"After exams or when I score good marks, my family treats me with ice cream or chocolates. That's how we celebrate." (P12, Male, 17, Private)
2. Peer Influence and Social Bonding Through Sugary Consumption	2a. Peer pressure and social acceptance	Sugary snacks and drinks were central to peer group activities and acceptance	"During break, all my friends drink Coke or eat chips. If I don't join, I feel left out from the group." (P8, Male, 14, Public)
2. Peer Influence	2b. Social Sharing	Sugary items	"We pool money to buy

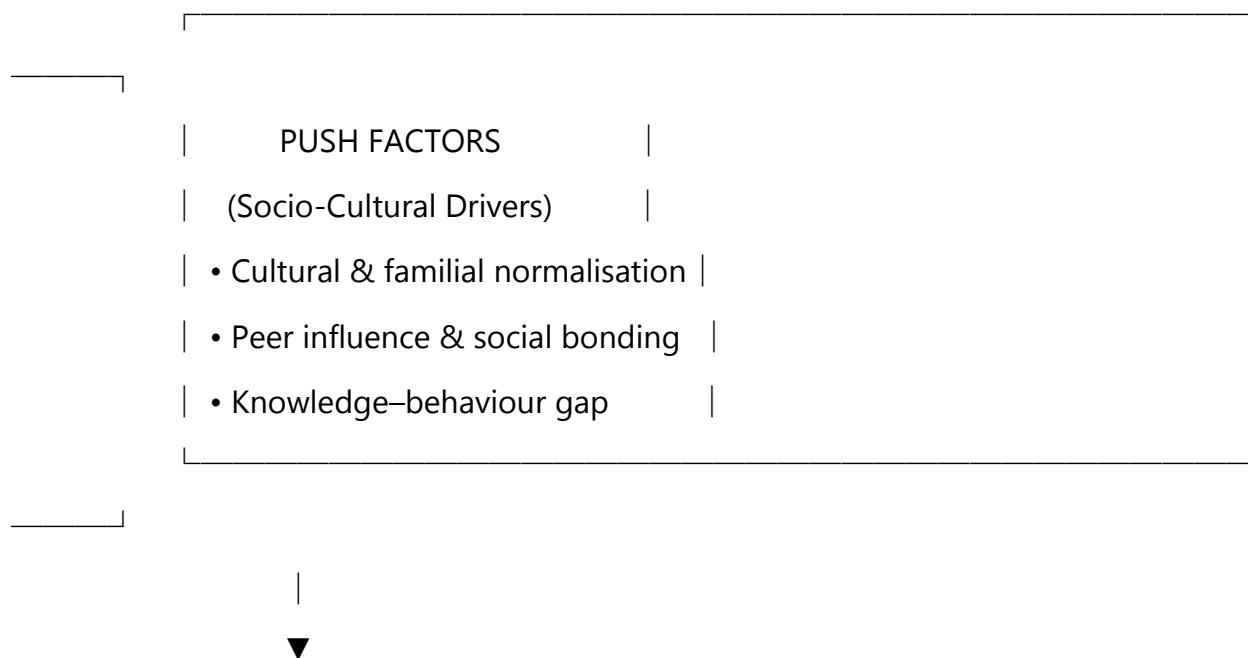
Theme	Subtheme	Definition	Representative Quotation
and Bonding Sugary Consumption	Social bonding Through shared treats	through strengthened friendships	Fanta or chips in the canteen and share it. That's our way of hanging out." (P19, Female, 17, Private)
3. Knowledge– Behavior Gap and Denial of Personal Risk	3a. Awareness without personal application	Participants knew general risks but did not apply them to their own habits	"I know too much sugar is bad for teeth, but I feel it only happens to other people, not me." (P5, Female, 17, Public)
3. Knowledge– Behavior Gap and Denial of Personal Risk	3b. Minimization and fatalistic views	Risk was downplayed through fatalism or short-term thinking	"Teeth problems come when you get old anyway. I don't think about it much right now." (P24, Male, 13, Public)
4. Accessibility Environmental Ubiquity of Sugary Products	4a. Affordability and easy availability	Low cost and widespread availability in schools/markets drove intake	"A cold drink costs only 20–30 rupees, but fruits or milk are more expensive." (P15, Female, 14, Public)

Theme	Subtheme	Definition	Representative Quotation
4. Economic Accessibility and Environmental Ubiquity of Products	4b. School market Sugary environment	Canteens and vendors promoted options	"Our school canteen street mostly sells chips, candy, heavily and soft drinks. There is sugary hardly any fruit or plain water." (P27, Female, 12, Public)
5. Lived Impact of Caries on Daily Functioning and Self-Image	5a. Pain, eating difficulties and daily disruption	Caries caused physical and functional limitations	"When my tooth hurts badly, I can't eat properly and sometimes miss school." (P6, Male, 12, Public)
5. Lived Impact of Caries on Daily Functioning and Self-Image	5b. Embarrassment and self-image effects	Visible caries affected confidence and social interactions	"I feel shy when smiling because of the black spots on my front teeth." (P21, Female, 18, Public)
6. Moral Residue and Conditional Orientation Toward Behavior Change	6a. Guilt, family concern personal conscience	Participants expressed and guilt over habits and concern for future health	"I know I'm harming my teeth by eating sweets, and but I still do it. It makes me feel guilty sometimes." (P10, Male, 13, Public)

Theme	Subtheme	Definition	Representative Quotation
6. Moral Residue and Orientation Toward Change	6b. Conditional willingness to Behavior change	Clear (cheaper school support) articulated reduction	conditions "If the school canteen alternatives, sold cheap fruits instead family of cold drinks and my were parents supported me, I for could try to reduce it." (P30, Male, 16, Public)

Figure 1. Thematic Illustration

Conceptual Framework of Sugar Consumption and Dental Caries in Pakistani Adolescents: Behavioral, Environmental, and Moral Dimensions



ENVIRONMENTAL FACTORS		PERSONAL EXPERIENCES	
• Economic accessibility & affordability		◀→	
• School canteen & market ubiquity of sugary products		daily disruption	
		• Pain, eating difficulties & embarrassment & impact on self-image	



PRICE OF CHANGE	
(Barriers to behaviour change)	
• Habit inertia & cultural norms	
• Lack of affordable alternatives	



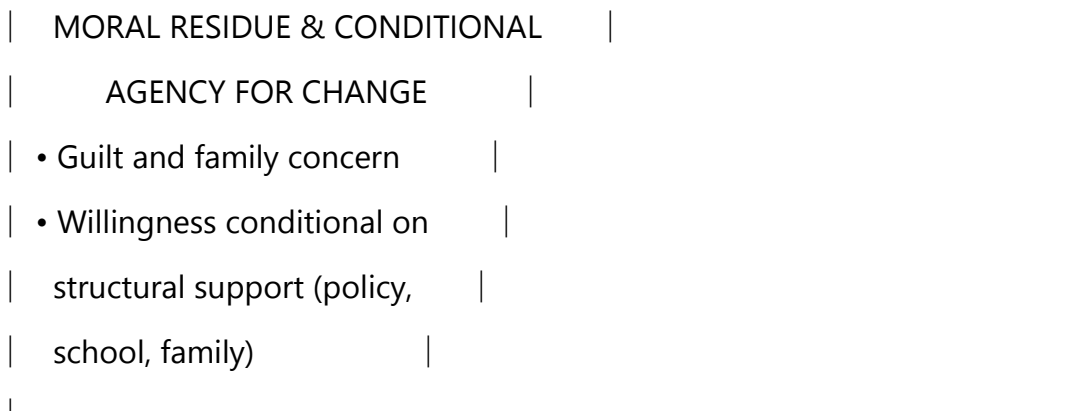


Figure 1. Conceptual Framework of Sugar Consumption and Dental Caries in Pakistani Adolescents (adapted from reflexive thematic analysis). The framework illustrates the interplay of push factors, environmental enablers, personal costs, and moral/conditional dimensions that sustain the sugar–caries association.

The six themes are organized across three conceptual planes. The first plane (Themes 1–2) represents socio-cultural drivers that normalize high sugar intake. The second plane (Themes 3–4) captures environmental and cognitive enablers that sustain the behavior. The third plane (Themes 5–6) addresses the lived consequences and moral texture of the experience, revealing conditional agency for change.

DISCUSSION

The findings extend quantitative evidence by revealing that the sugar–caries association among Pakistani adolescents is not merely behavioral but deeply embedded in socio-cultural, economic, and environmental contexts. Themes align with global literature while highlighting Pakistan-specific factors such as family norms and school environments. Policy implications include regulation of sugary products in schools, affordable healthy alternatives, and adolescent-inclusive education campaigns. Limitations include sample

geographic focus; transferability to other settings should be assessed.

CONCLUSION

Adolescent sugar consumption and dental caries in Pakistan are driven by cumulative socio-cultural and environmental factors rather than isolated individual choices. The retention of conditional agency for change offers a hopeful pathway for targeted interventions. Comprehensive structural reforms are essential.

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