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What influences Indian primary school children's food behaviors? - Perceptions of children, mothers and teachers

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Abstract

Background Development of healthy food behaviors in childhood is significant for optimum growth and development of children as well as future health. However, many Indian children display unhealthy dietary habits including poor intakes of fruits and vegetables and excessive consumption of calorie-dense, nutrient-poor foods and sugar-sweetened beverages. Therefore, the factors that influence their daily diet need to be explored for developing future interventions and policies. In this light, the present inquiry was designed to examine the various influences on the food behaviors of Indian primary school children.

Methods Informed by the socio-ecological framework, this study used an exploratory qualitative research approach to conduct semi-structured interviews with 22 primary school children, 19 mothers, and 18 teachers residing in Varanasi, India. For children, the interviews were preceded by a drawing session where the interviewees were asked to draw their preferred and non-preferred food and beverage items. Interviews were carried out in English or Hindi and digitally recorded. Interviews were conducted until data saturation was achieved. Digital recordings were transcribed verbatim and translated to English (where necessary) for the purpose of thematic analysis. The transcripts were coded both deductively and inductively using the NVivo software program.

Results Individual level influences included taste and nutritional knowledge. At the interpersonal level, the family food environment and peers emerged as key determinants. The physical environment also played a pivotal role in determining food behaviors, with the school food environment and food availability in the marketplace being significant. Lastly, at the societal level, television and internet advertisements were frequently cited as important determinants of children's food behavior.

Conclusions The collective insights from the three stakeholder groups have the potential to inform public health nutrition policies and interventions targeting the different socio-ecological factors to encourage healthy eating in Indian primary school children.

Keywords India, Primary school children, Food Behaviors, Qualitative

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Background

Optimal nutrition in childhood is critical for physical growth and cognitive, motor, and psychosocial development as well as future health [1]. Childhood presents an ideal time to inculcate lifelong healthy eating habits as these habits track into adulthood [2]. Yet, many children around the world fail to meet their daily requirements of fruits and vegetables as well as display obesogenic dietary patterns (i.e., excessive consumption of calorie-dense, nutrient-poor foods and sugar-sweetened beverages) [3–8]. Similar concerns regarding Indian primary school children's (5–11 years) diets have been reported in the literature [9, 10]. The diets of most of them are devoid of several macro and micronutrients [9, 10].

Poor quality diets are known to adversely impact the growth and development of children and consequently result in increased childhood morbidity and mortality [1, 11–14]. Indeed, Indian children are at high nutritional risk, facing enduring health issues such as undernutrition (i.e. underweight, stunting and wasting) [15] and micronutrient deficiencies including iron-deficiency anemia and Vitamin A deficiency [16, 17] along with emerging health concerns about overweight and obesity [18, 19]. To curb this triple burden of malnutrition among Indian children, it is essential to understand the factors influencing their food behaviors. This has the potential to inform the development of healthy eating interventions to improve the eating habits of Indian children.

A substantial body of evidence indicates that children's food behaviors are influenced by several factors [20–26]. They may either facilitate or hinder healthy eating practices [27–29]. Hitherto, food researchers have employed socio-ecological models [30, 31] to explain multiple levels of influence on food behaviors [27, 32, 33]. Some common individual (intrapersonal) determinants include food preferences, nutritional knowledge and attitudes towards healthy eating [20, 28, 32, 34]. At the interpersonal (social) level, children's food behaviors are influenced by their parents, friends, and school educators [20, 34]. The school food environment and food accessibility in the neighborhood have been identified as significant predictors of food behaviors at the community (physical environmental) level [24, 34] while mass media, advertisements, and government and industry food policies are commonly recognized societal (macrosystem) influences [20, 24, 28].

Studies of the influences on children's food behaviors have mostly been conducted in the global north [20, 21, 26], and there is paucity of such studies in the global south. Moreover, most of the existing evidence is primarily based on the perceptions of caregivers. The views of other critical stakeholders, including children and teachers, regarding the influences have not been well studied. Previous studies exploring family meals indicate that caregivers and their adolescents often share different perspectives about family meals and healthy eating [35, 36]. Interestingly, children's responses have been found to be vivid and more accurate compared to caregivers' responses. [37, 38]. Teachers' views are also significant as they are responsible for disseminating nutritional knowledge in the classroom and may be expected to be well-informed about the food habits practiced by their pupils during school hours [39].

The application of a qualitative research approach was warranted in the present context as it allowed for a deeper understanding about the diverse socio-ecological determinants of food behavior as well as any culture-specific influences which might not be elucidated by quantitative research methods. Therefore, this qualitative research inquiry was designed to examine primary school children's, mothers' and school teachers' perceptions of the socio-ecological influences on children's food behaviors in India using semi-structured interviews to inform the development of culture-specific healthy eating interventions.

Methods

Study design and research team

Guided by Story and colleagues' ecological model [40], the present inquiry adopted an exploratory qualitative research approach [41] to provide first-hand, in-depth information about personal and contextual factors that influence Indian primary school children's food behaviors. Derived from the social cognitive theory [42] and Brofenbrenner's ecological model [43], Story and colleagues' integrated, composite, theoretical framework encompasses four levels of influence which interact and impact dietary behaviors, thus, validating its use in the present context [40].

Following the principles established in the consolidated criteria for reporting qualitative research (COREQ) checklist (See Supplementary Material 1) [44], the present study was conducted between November 2023 and June 2024. The multi-disciplinary research team comprised a mid-career female researcher (NR) specializing in qualitative health behavior research, two senior female home economists (MS, KG) having expertise in food science and child development respectively, one retired male professor of food psychology (AW), and three active female students (AP, MK, PT) pursuing a postgraduate degree in food and nutrition. Prior to data collection, the three students underwent training in conducting qualitative research interviews and thematic analysis. The research protocol for this inquiry was approved by

the Ethics Committee of the Banaras Hindu University (DEAN/EC/2817).

Participants and recruitment

The present study used a purposive sample of primary school children, mothers, and teachers from both public (non-fee paying) and private schools (fee-paying) in Varanasi (Varanasi is a city located in the most populated state of India – Uttar Pradesh). Undernutrition is more common among pupils attending public schools whereas overweight and obesity are more prevalent in private school attendees in India [45]. Primary school children (aged 8–11 years) studying in 3rd – 5th grades were recruited. According to an integrative literature review most children between the ages of 7–12 years enjoyed sharing their perspectives and were capable of providing valuable and accurate information about the topic under investigation [46]. Moreover, this age group (8–11 years) is a critical period for nutrition promotion as it marks the transition from late childhood to early adolescence wherein children start practicing more autonomy in their food choices [47]. This age-group (8–11 years) coincides with Piaget's concrete operational stage in which children are expected to have better cognitive skills including enhanced language skills, logical and systematic thinking when compared to a younger cohort of children aged 5–7 years [48]. Mothers' perspectives were also considered vital for this inquiry because they have been recognized as the primary household dietary gatekeeper [49] as well as the primary caregiver of children [50, 51].

The senior author (NR) sought permission from the school principals of two public and two private schools to conduct this study. She introduced the study to the primary school children and teachers during the school morning assembly while mothers were invited through a short note communicated by the school authorities via pupils' school diaries. Interested participants were provided with the consent form, assent form (only for children), and plain language statement.

Data collection

Upon receiving informed consent from mothers, teachers and children's parents, interviews were conducted during school hours within a classroom where no one was present except the individual participants and the researchers. Fifty-nine interviews were completed in which 55 were face-to-face while four interviews (teachers – 2; mothers – 2) were carried out over telephone. At the beginning of the interviews, socio-demographic information was collected from all the interviewees. The research team informed the interviewees that there were 'no right or wrong answers' and they were free to opt out of the inquiry at any point. They were further notified that the conversation would be audio-recorded, and the information shared by them would be kept strictly confidential.

In the presence of a note keeper (PT), NR conducted all the interviews in English or Hindi (local language) as per the preference of the interviewee. Data was collected until saturation (i.e. the point in data collection when no additional themes/ideas were identified) was reached [52]. The average duration of the interviews was 29 min (ranging from 11 to 46 min). The participants did not receive any compensation for their time. In the case of children, the interviews began with a drawing session in which the participant was asked to draw food and beverage items which he/she liked or disliked eating. This session of 30 min facilitated rapport building and stimulated the children to express their opinions. Probing (e.g., other than this food item drawn by you, do you like any food item? If yes, why?) was used particularly in the case of children's interviews because they usually gave very short answers.

Based upon a review of literature, [39, 53, 54] and the study research objectives, three distinct interview guides were developed and piloted with two teachers, two primary school children, and two mothers to improve clarity and facilitate understanding by the participants. The final refined instruments are presented in Table 1.

Data analysis

All the recordings were transcribed verbatim by AP and translated to English (where required) by MK. Prior to coding, PT checked the transcripts for accuracy and requested the mothers and teachers to review their respective transcripts and share their feedback. None of the mothers showed interest in reviewing the transcripts, however, four teachers agreed to participate in respondent validation [55]. Subsequently, the transcripts were shared with the four teachers over email and none of them either raised any concern regarding interpretation of the data or suggested any modifications in the transcript, thereby minimizing the possibility of bias associated with data interpretation. The use of multiple data sources (i.e. primary school children, mothers, and teachers) facilitated data source triangulation [56] thus validating the findings.

Guided by the reflexive thematic approach [57], the transcripts were analyzed in six phases: (i) Data familiarization; (ii) Labelling and organizing data to form initial codes; (iii) Sorting of codes to generate initial themes (iv); Reviewing and refining codes and themes; (v) Defining and naming themes; (vi) Writing a comprehensive report based on themes [58]. Transcripts were coded independently by two researchers experienced in qualitative data analysis: NR and PT. If there

Table 1 List of open-ended questions for the three stakeholders

Questions for children	Draw your favorite food and drink
	Why do you like them?
	Is there any food or drink you don't like? Draw them
	Why don't you like this food or drink?
Questions for teachers	What kind of food and drinks do primary school children like to eat these days and why?
	What do you think about the nutritional quality of food and drinks primary school children consume nowadays?
	How do you promote healthy eating practices among your students?
	What is the most likely influence on primary school children's diet?
Questions for mothers	What kinds of food do you think your children should eat?
	How do you feel about your children's current diet?
	How do you influence what your children eat?
	Do you feel there are other sources of influence over what your children eat?
	Are there any areas of conflict over food?
	How do you manage these?

were discrepancies, a third coder (MK) was consulted to resolve the conflict. Codes were identified using both deductive and inductive coding. First, codes corresponding to the four levels of intrapersonal, interpersonal, physical environmental, and societal influences on children's food behaviors as outlined in Story and colleagues' socio-ecological framework [40] were generated deductively. Subsequently, inductive coding was implemented to identify any additional determinants (codes) of food consumption in each level of the socio-ecological model. The NVivo (Version 15) software program was used to facilitate the coding process.

Results

A total of 59 participants (22 children, 19 mothers, 18 teachers) were interviewed. The mean age of children, mothers and teachers were 9.59 (SD 1.007) years, 37.21 (SD 3.37) years and 37.22 (SD 6.68) years respectively. Among children (10 boys, 12 girls), 10 attended private schools while the remaining 12 children went to public school. With regards to teachers (6 males, 12 females), seven of them were teaching in private schools while the rest were employees of government schools.

Themes

Seven key themes and associated sub-themes were identified and described the various influences on Indian primary school children's food behaviors: (i) Taste; (ii) Nutritional knowledge; (iii) Family food environment; (iv) Peers; (v) School food environment; (vi) Easy availability of unhealthy food in the market; (vii) Advertisements (Fig. 1).

Taste

Taste emerged as one of the most significant determinants of primary school children's food behaviors during the 59 interviews. The respondents noted that children predominantly preferred unhealthy foods like pizza, noodles, burgers, chips, cakes because of their strong taste and hyper-flavor. This penchant for calorie-dense, nutrient-poor foods is also reflected in the drawings prepared by our participants (Fig. 2). On the other hand, children showed aversion towards healthy foods particularly green vegetables because of their bland or bitter taste as described by all the stakeholder groups. Few mothers lamented that it was challenging to feed vegetables to their young ones as they were fussy eaters and used to often throw tantrums while consuming green vegetables. In order to overcome this fussiness, mothers used to feed green vegetables by disguising their presence (kneading the vegetable puree in a dough for Indian flat bread) or make attractive recipes (replace potato patties with spinach, peas and carrot patties in burgers).

> *"Generally, children do not like vegetables because they don't like the taste……They enjoy eating fast food. They like to drink Maaza (Brand name for sweetened mango drink), Frooti (Brand name for sweetened mango drink), cold drinks."(T9, P, F, 38 years).*

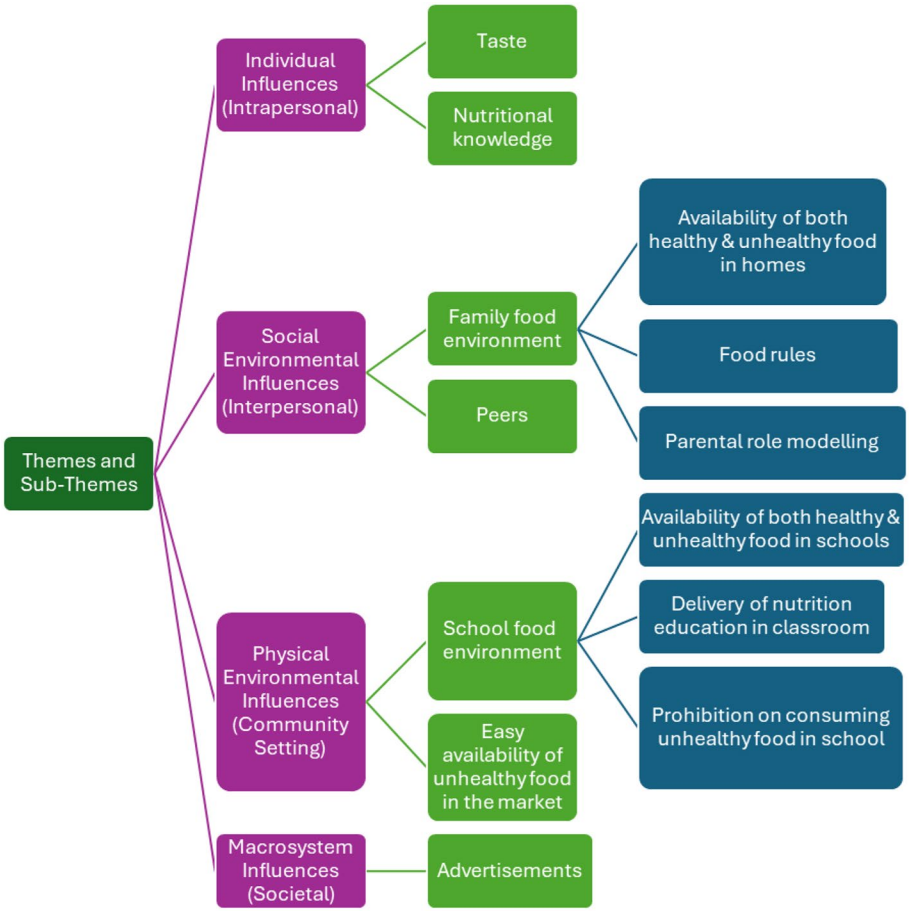

Fig. 1 Key influences on primary school children's food behavior are summarized according to the socio-ecological model

"She does not eat brinjal, the younger one does not eat bitter gourd also if it is made. They don't like the taste of vegetables. Nowadays, they are attracted to pizza and burgers. They find them very tasty." (M9, 35 years).

"Yes, Maggi (Brand name for instant noodles). I like it because it is spicy and flavorful." (C1, P, M, 8 years).

"I like pizzas and burgers Because they are perfect in taste." (C11, P, M, 10 years).

Nutritional knowledge

All the primary school children in the study reported that they were aware of the nutritional and health benefits of consuming healthy foods as well as the ill-effects of unhealthy foods. They claimed that they acquired this knowledge from either their parents or teachers.

"Paneer (Cottage cheese) is tasty. It is good for our health. That's why I like it a lot. Paneer gives protein to the body." (C12, P, M, 9 years).

"Mango is good because it contains vitamin A, and chips contain fats which is not good for health." (C19, G, F, 10 years).

"I like stuffed parantha (Indian flat bread) very much. It has a lot of vegetables. My mom says vegetables make us stronger and we get vitamins and minerals from it." (C4, P, M, 11 years).

"My father says that I should eat everything. I don't like chana dal (Indian pulse preparation) and spinach. So, my father says that I should taste them as all these are good for my health." (C15, G, F, 10 years).

Family food environment

This social environmental influence was supported by three sub-themes that highlight how availability of

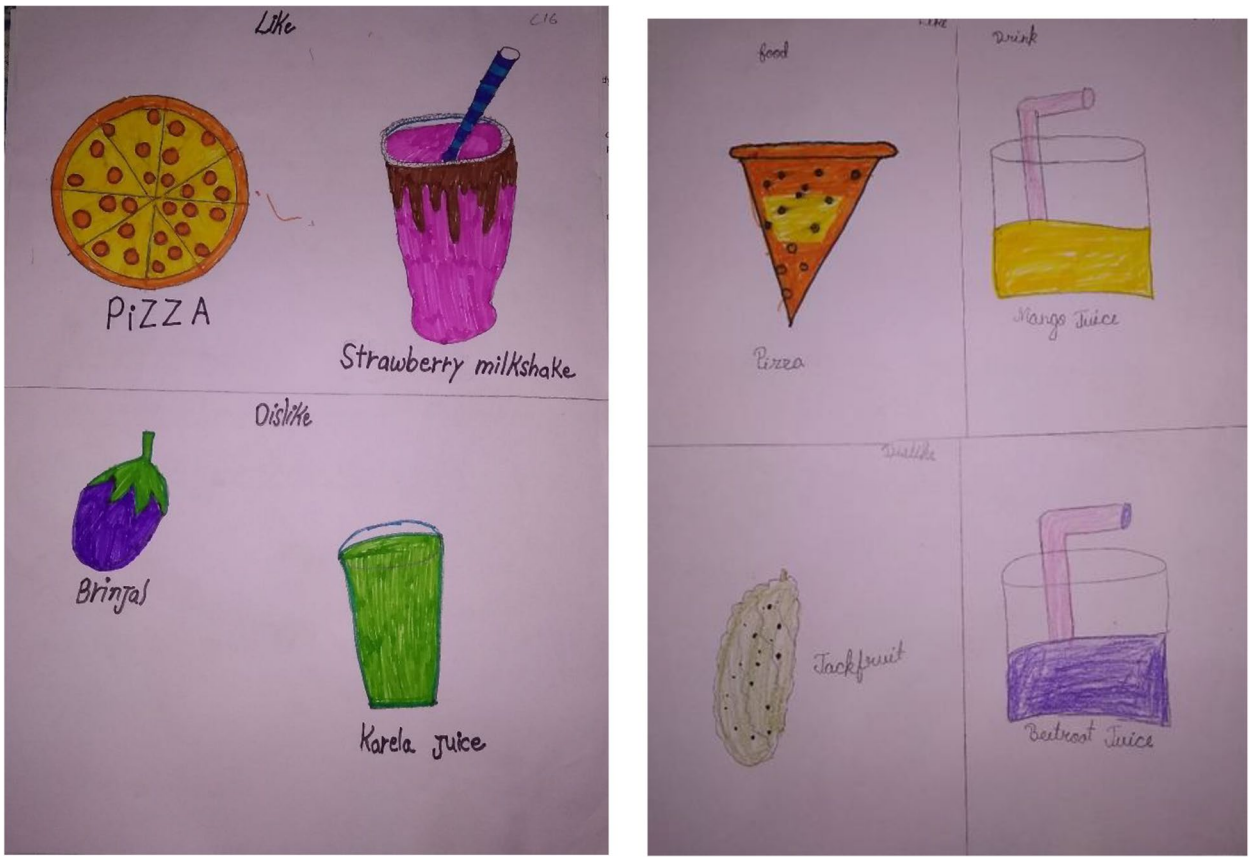

Fig. 2 Examples of children's illustrations of their preferred and non-preferred food and beverage items

healthy and unhealthy foods in the home food environment, family mealtime rules, and parental role modelling play a crucial role in determining primary school children's food habits.

Availability of both healthy and unhealthy food in homes Varied views were recorded about the availability of healthy and unhealthy foods in the homes of primary school children. All mothers mentioned preparing nutritious meals and serving them to their children. For the lunch box, healthy food was prepared and packed as informed by the maternal gatekeepers. These views were also echoed by several children as they informed that their mothers mostly prepared healthy meals and snacks and fast food was rarely prepared in their homes. On the contrary, the majority of the teachers criticized the home food environment. They believed that modern Indian parents were mostly irresponsible about their children's diet and therefore they would mostly send pre-packed food in the lunch box. A few teachers also lamented that mothers were not well-informed about the dietary requirements of their children as well as some of them were labelled lazy in cooking. Teachers often complained that parents would allow their children to watch television or play with mobile phones while eating.

> *"She doesn't want to eat roti (Indian flat bread) so I have to make aloo paratha (Indian flat with potato stuffing inside) for her which she enjoys eating." (M14, 35 years).*

> *"Usually, children are attracted to pizza, burger, but you cannot feed them every day as they contain refined flour. So, I try to make the pizza base and bun at home either with whole wheat flour or multigrain flour." (M15, 34 years).*

> *"My mother cooks chapati-sabji (Indian flat bread – Vegetable), Maggi (Brand name for instant noodles) for my lunch." (C2, P, M, 11 years).*

> *"Mummy cooks healthy food at home….." (C10, G, F, 11 years).*

> *"Parents nowadays are not aware; they haven't instilled good eating and drinking habits in their*

children. You see, if parents have consumed those things, children will also consume them." (T16, G, F, 38 years).

"Nowadays, there is another problem among these children. They will either eat by watching mobile or watching TV. Parents have inculcated these bad habits in their children since childhood." (T10, P, F, 39 years).

".....I think today's parents have become very lazy. Several parents even have servants, yet they still prefer to order food from outside."(T8, P, F, 35 years).

"Children mostly bring Maggi (Brand name for instant noodles) as the parents think that this gets cooked quickly and sometimes, they even give biscuits."(T3, G, M, 32 years).

"Chips, Kurkure (Brand name for deep fried corn meal) and other packaged items have a bad impact on the child's health. If they are getting all these things easily at home then why wouldn't children eat it? If parents buy it, then they will definitely eat it." (T9, P, F, 38 years).

Food rules Only mothers and children discussed the implementation of mealtime rules during the interviews. Both the stakeholder groups talked about restrictions on consumption of fast food from restaurants. In most households, parents used to take their children once a week/month to fast food eating joints. In some households, mothers would prepare fast food on children's demand only once a week/fortnight. Some mothers also prohibited television viewing while eating, however this rule was frequently flouted by children. Some parents did not allow the children to waste food as noted by our young participants.

"See I tell them not to watch TV while eating but nobody listens! My husband has made it mandatory that nobody should leave any food on the plate. Everyone should finish their meals." (M3, 40 years).

"Papa does not allow me to use the mobile phone at dinner." (C6, P, M, 10 years).

"If I waste food Mummy scolds me so I have to eat everything served on the plate." (C18, G, F, 9 years).

"Nowadays, children like junk food so you cannot forbid them from eating. If you forbid something, then curiosity for it increases. So, once a week I prepare junk food of their choice. I prepare it in such a way that it does not cause much harm." (M19, 41 years).

"See it is mother's job to feed their children healthy food. But children are very stubborn. They want junk food daily. Their taste buds are changing. We have a fixed routine. On Sundays, we take them out for lunch or dinner." (M12, 38 years).

Parental role modelling Teachers recognized parents as important role models for their children's food behaviors. They expressed concern over parents' unhealthy eating habits and children's innate tendency to copy their parents' eating habits. In this light, the teachers emphasized the need for parental role modelling of healthy eating. They noted that parents themselves should rectify their eating habits, and this could facilitate a positive change in their children's eating habits.

"As far as I know junk food consumption is being promoted at home. Children can be stopped from eating junk food. But junk food has been provided to them by their parents since childhood. Parents themselves are consuming such food. But the sad part is that parents always blame the teachers for not stopping the children from eating junk food. See we don't allow junk food consumption in school. Parents must take some responsibilities....." (T1, G, M, 45 years).

"See children are not at fault. Children eat whatever comes to their house. They will eat whatever their parents eat at home. Let's say if parents eat traditional food, then the child will develop the taste for that food and eat it. So, parents should first prepare and consume healthy food at home and then ask children to have healthy food." (T4, G, M, 42 years).

Peers

Unanimously, all the interviewees believed that the peer group played a significant role in determining children's food choices. However, it was further noted that peers largely exerted a negative influence as most of them brought unhealthy food items in their lunch boxes. Children often mimicked the unhealthy dietary behaviors of their friends as narrated below:

"....One of my friends brought a burger in the tiffin (lunch box). I liked it and told my mother to make it for me." (C21, G, M, 9 years).

"One day my son said that his friends bring really good things to school. I give simple things. You gave

me vegetable parathas (Indian flat bread). You give me cabbage curry, potato curry. Why don't you give me French fries, noodles……They see other children and they just want to copy their friends." (M10, 37 years).

"Let's say there are four children who are friends. If one child brings Maggi (Brand name for Instant noodles) and the other three bring rotis (Flat Indian bread), then it's certain that in the next ten days, all four will bring Maggi because they observe each other. Bringing that Maggi becomes a standard for them. They will go home and tell their mothers, 'My friend brought Maggi, I also want it, and they will bring it in their lunchbox". (T-18, P, M, 38 years).

Considering this negative influence, several teachers discussed peer role modelling and its positive impact on dietary behaviors. They recommended that peers should be trained to practice healthy eating behaviors and subsequently serve as healthy eating role models for their classmates.

"See we have to train students and parents regarding healthy eating. If students bring lunch to school, then they can set a good example for their friends. If a friend brings healthy food in his tiffin, then the child will also want to bring healthy food from home and he will ask his mother to give healthy food in tiffin, then his parents will definitely give it to him." (T4, G, M, 42 years).

School food environment

This theme was supported by three sub-themes that shed light on how the availability of both healthy and unhealthy foods in schools, teachers' provision of food and nutrition education, and prohibition on consuming unhealthy foods in schools influence primary school children's eating habits. This physical environment influence was only cited by teachers and children during interviews.

Availability of both healthy and unhealthy foods in schools Mixed views were reported regarding the food provision in schools. Teachers and children from public schools mentioned that only hot healthy meals were made available to primary school children free of charge. In contrast, some private school children reported that calorie-dense, nutrient-poor foods like pizza, burgers, and deep-fried Indian snacks were available for sale in their school canteens. In addition, a small minority of children, particularly the public school attendees, noted that although unhealthy food was not available in their schools but outside the school premises street vendors used to sell potato chips and other unhealthy snack items during recess and after school.

"In school, healthy food is prepared keeping their nutritional requirements in mind. Food is prepared according to the sanctioned menu, they are given fruits and milk once a week, only seasonal vegetables are cooked." (T11, G, F, 42 years).

"Sometimes I eat in the canteen. We get cold drinks, momos, burgers, patties, and rolls in the school canteen." (C8, P, M, 11 years).

"We get hot lunch in school…..we get roti (Flat Indian Bread), sabji (Vegetables), dal (Pulses), khichdi (Porridge of rice and pulses)." (C9, G, F 11 years).

Delivery of nutrition education in classrooms Both teachers and children reported that teachers disseminated food and nutrition knowledge in classrooms. It was observed that teachers explained the benefits of consuming healthy foods and the ill-effects of consuming unhealthy foods as part of the science curriculum. Few children also informed that they read about healthy and unhealthy foods from their science textbooks.

"I explain to children through pictures which food items will have a bad effect on the health of children. In class I tell them that they should eat less junk food and eat more green vegetables"(T12, G, F, 51 years).

"Bitter gourd is good for health. I read it in the textbook." (C16, G, F, 9 years).

"When we were in class 3, one of our teachers taught us what are healthy foods and what are junk foods." (C20, G, F, 9 years).

Prohibition on consuming unhealthy food in school Some teachers and children claimed that children were debarred from consuming unhealthy foods in school. They further noted that if children brought unhealthy foods in their packed lunch, then teachers would scold them and at the same time teachers would praise those children who brought healthy packed lunch.

"We are not allowed to bring junk food in tiffin (lunch box), so we bring normal food like vegetables and chapati (Indian flat bread)." (C13, G, F, 13 years).

"Yes, everyone does bring burgers and chips in tif-

fin. I don't bring that often now. Teachers say not to bring junk food to school." (C15, G, F, 10 years).

"We promote from here (school) that you should not bring all these things. Junk food from outside is totally prohibited here. We forbid all this, we do not allow consumption of chips, cakes in classroom."(T1, G, M, 45 years).

"I tell them that packaged food is not allowed in the school so do not bring it from tomorrow. But still few children bring it."(T8, P, F, 35 years).

Easy availability of unhealthy food in the market

In line with the theme of school food environment, the present theme was exclusively cited by children and teachers. The interviewees discussed that calorie-dense, nutrient-poor foods were more easily available online, in markets situated in residential areas as well as in local shops located in the school neighborhoods when compared to healthy foods making it readily accessible for children to purchase. In addition, a handful of teachers also claimed that unhealthy foods were sold in attractive packaging and less expensive compared to nutritious foods like fruits, thus making them more popular among the young ones.

"My father ordered it (Pizza) online. I ate it for the first time. I liked it very much." (C21, G, M, 10 years).

"Junk food is available everywhere. Children get attracted by seeing them and then they choose them because they are cheap and attractive...."(T11, G, F, 42 years).

Advertisements

All the stakeholders strongly believed that food and beverage commercials on television and internet had a long-lasting, specifically a negative impact on children's food behaviors. The eye-catching advertisements of high-calorie, low-nutrient foods and aerated drinks grabbed children's attention and subsequently prompted them to consume such unhealthy food and beverages. It was further noted that commercials promoting healthy foods and drinks rarely featured on electronic and social media. Some mothers also mentioned that their children insisted on watching television or smart phone while consuming their meals.

".....take the example of a burger, children like it on TV or mobile so much that whenever they go outside they demand burgers!" (T6, P, F, 28 years).

"Children get the idea of eating junk food primarily from TV advertisements, and these ads often show appealing and spicy foods which attract children...." (T15, G, F, 48 years).

"When I watch TV, there is an ad on TV regarding pizza, I want to eat pizza instead of chana dal (Bengal Gram pulse). So, I told my mom that I want to eat pizza and not chana dal. So, she said that I should eat chana dal first then only she'll buy me pizza." (C20, G, F, 9 years).

"I don't know from where he saw on YouTube that cheese is very healthy. He likes cheese sandwiches and cheese burst pizza a lot." (M6, 42 years).

Discussion

In order to explain children's food behaviors and developing effective dietary interventions to improve these behaviors, it is crucial to gather insights from children, their primary caregivers, and teachers regarding determinants they view as influencing their dietary choices. This inquiry identified a broad range of factors including taste, nutritional knowledge, family, friends, school, and mass media that could potentially affect Indian primary school children's food behaviors. These diverse factors complement existing scholarship on determinants of children's eating behaviors as well as provide unique insights from the global south.

During the interviews, taste emerged as one of the most important intrapersonal influences on children's food behaviors. Indeed, taste is widely recognized as a nutrient sensing system which plays a key role in appetite, food choice, consumption, and satiation [59]. Experimental research suggests that children in general prefer sweet taste and dislike bitter taste [60–62]. This is also reflected in the conversations with our stakeholders and children's drawings of their preferred and non-preferred food and beverage items. Fruit juices, sugar-sweetened beverages, pizza, fries, and burgers were the most popular items while vegetables and vegetable juices were the least popular among our young interviewees. Likewise, increased preference for sugary and fatty foods was also demonstrated by British [63, 64], European [65], Australian [66], and Nepalese [67] children. These unfavorable taste preferences have often been associated with overweight and obesity in children [65]. Nonetheless, taste preferences can be acquired or unlearned [68] through taste education [69] and social learning strategies (e.g. repeated exposure to healthy foods at early age) [70, 71].

Another important intrapersonal determinant cited during the interviews was nutritional knowledge. However, this factor was exclusively discussed by children only. Interestingly, our young participants claimed to

be aware of the health benefits associated with the consumption of nutritious food as well as the detrimental effects of consuming unhealthy food. Despite this awareness, the majority of the children exhibited unhealthy eating habits. These findings are mirrored by Kigaru and colleagues who reported that Kenyan school children ($N=202$; aged 8–11 years) demonstrated moderate nutritional knowledge which had no significant relationship with their eating habits [72]. Nearly three quarters of the Kenyan children had consumed sugary drinks and junk food in the previous seven days of the survey [72].

This lack of association between children's nutritional knowledge and dietary intake is also apparent in adolescents [73] and adults [74]. One possible reason for this disassociation could be that knowledge of nutritional facts may not be enough to cultivate healthy food behaviors in children [75] or in adults [74]. Considering this, skills-focused nutrition education programs should be designed to inculcate tacit nutritional knowledge in children [73, 75], thereby supporting them to adopt healthy eating habits.

The family food environment was cited as a significant interpersonal driver of children's food consumption in our study. Consistent narratives surrounding home food availability, food rules, parental role modeling have been reported in both local [50, 76, 77] and international studies [20, 34]. Healthy food was predominantly available in homes and parents often imposed restrictions on children's frequent consumption of unhealthy food in homes and restaurants. Comparable views have been reported by Indian parents [77] as well as Singaporean children [34]. Nonetheless, unhealthy food was also available in children's homes because of parents' hectic work schedules or poor nutritional knowledge as lamented by our teachers. In the same vein, American [29], Ecuadorian [78], as well as Indian mothers [77] complained about their overwhelming work schedules which inhibited them from preparing healthy meals for their children and families.

Our teachers further aired their disappointment over unhealthy eating habits practiced by Indian parents. They proposed that parents should be encouraged to adopt healthy eating habits because children consider their parents as their main role models and tend to imitate parental eating habits, a recommendation also endorsed by a recent narrative review [22]. Therefore, parents need to be provided with essential information and guidance on practicing positive and active social modelling children's dietary habits [22, 79]. Also, parents and children should dine together as a family because it provides a valuable setting for parents to model healthy eating habits [80].

Another social determinant of children's food behaviors was the peer group. All the stakeholders believed that peers largely exerted a negative influence on children's diet as children frequently mimicked their peers' unhealthy eating habits and also savored unhealthy treats in the company of their peers. Again, this is consistent with the findings of a recent systematic review [81]. To counteract this negative impact, our teachers recommended that peers should be trained to serve as positive role models of healthy eating, a viewpoint often cited in the literature [81–83]. Peer encouragement of healthy eating has been associated with children (10–17 years) eating more nutritious food but also with children consuming fewer high calorie, nutrient poor foods [84]. Furthermore, higher peer social functioning has been associated with healthy dietary habits among children [85].

The school environment emerged as a notable influence at the community level. Public school stakeholders mentioned that freshly prepared healthy hot meals were provided during lunchtime; however unhealthy packaged food and drinks were readily available in shops located in the school vicinity. Both the central and state governments in India are responsible to implement the Mid-Day Meal scheme (provision of free hot cooked meals) in public schools to improve the nutritional status and scholastic performance of attendees as well as reduce school dropout rates [86–89]. On the contrary, private schools in India have been criticized for selling energy-dense, nutrient-poor foods in school canteens. Indeed, the school food environment in Indian private schools [90, 91] and other developing [92, 93] as well as developed countries [94, 95] promotes obesogenic dietary behaviors in pupils. One possible reason for this obesogenic food environment could be the lack of effective and sustainable school food policies [90, 96], thus highlighting the need for effective and sustainable school eating policies.

Despite the prevailing unhealthy school food environment, both public and private school teachers discouraged children from bringing unhealthy packaged foods to school and even barred them from consuming such food in school. Interestingly, the teachers also delivered healthy eating messages as part of the school curriculum. This further sharpens the need for designing healthy eating policies which complement healthy eating lessons to support primary school children in adopting healthy food behaviors. School food policies should be framed in consultation with all the key stakeholders including children to maximize its efficacy.

Apart from the school food environment, the availability of unhealthy food in the neighborhood market also emerged as a potential determinant of primary school children's food behavior, corroborating evidence from the wider literature [77, 93, 97, 98]. This calls for targeted interventions including zoning law and healthy food carts

to limit the availability of unhealthy food in the neighborhood food market [99].

Television and social media food advertising attracted harsh criticism from all our stakeholders because of its negative impact on primary school children's food behaviors, a criticism widely published in the past [100–103]. Certainly, food advertising is ubiquitous, it largely promotes energy-dense, nutrient-poor foods and sugary drinks and even short-term exposure has been associated with significant increases in food intake, food preference and purchase requests in children [101, 104]. Children's immature emotional and cognitive development makes them highly vulnerable to the negative effects of pervasive food marketing [105]. This reinforces the need for designing and implementing unified and impactful food policies which can effectively restrict the marketing of unhealthy food and drinks to which children are exposed [104, 106, 107]. For example, Chile implemented the Food Labeling and Advertising policy in 2016 to curb the surge in pediatric obesity [108, 109]. This policy was executed through font-of-package warning labels, restricting food advertising on television and banning sales of packaged foods and drinks high in calories and added sugar, sodium and saturated fat in schools which resulted in notable declines in purchases of unhealthy packaged food and drinks [108, 109]. Perhaps, Indian policymakers might consider implementing this Chilean food law to limit food advertising to primary school children.

Strengths and limitations

To the best of our knowledge, this is one of the first qualitative inquiries exploring the perceptions of children, mothers, and teachers regarding the determinants of Indian primary school children's food behaviors in India. The most prominent feature which emerged during the 59 interviews was the unanimity in the reporting of several socio-ecological determinants of Indian primary school children's food behaviors. The strong similarities in the reported themes highlight the significance of targeting these determinants in prospective behavioral nutrition interventions for primary school children.

The use of in-depth qualitative interviews in the present study allowed us to gather novel insights and ideas about the dietary determinants, therefore contributing to the poorly studied topic in India and other developing countries. Nonetheless, there are some limitations which need to be acknowledged while interpreting the current findings. One limitation is that the study was conducted in an urban setting, thus the perspectives of our urban sample may not be generalized to the rural Indian population. Further research is warranted to explore the views of children, mothers and teachers residing in rural settings. Another limitation could be that no fathers were interviewed regarding the dietary determinants. Although fathers' views are critical [50, 51], however mothers were only recruited because they are the key food gatekeepers as highlighted in previous local studies [39, 49]. Further there was dominance of female educators in our sample. This could be explained by the fact that the teaching profession in Indian schools is mostly dominated by females [91, 110–112]. Nevertheless, both male and female educators irrespective of the school type (public/private) shared similar views about dietary influences. Lastly, the four levels of our socio-ecological model did not entirely predict the participants' views, and this could be attributed to the limited experience of the study participants with macro level factors of our model. Moreover, in the present context the social-ecological model was used as an initial hypothetical model to assist coders in organizing the preliminary codes.

Conclusions

Overall, the collective thinking among the three stakeholder groups provides a comprehensive picture of the multitude of interactive socio-ecological determinants influencing Indian primary school children's food behaviors. The key findings were that nutrition knowledge and taste influenced food behaviors at the intrapersonal level while the family food environment and peers emerged as interpersonal determinants. The school food environment and easy availability of unhealthy packaged food in the marketplace comprised community level determinants and food advertisements featuring on television and internet formed the societal level determinant. In-depth understanding of these determinants of children's food behavior has the potential to contribute to the foundation of effective and sustainable nutrition interventions and policies targeting the different levels of socio-ecological model to inculcate healthy dietary habits in primary school children in India and elsewhere.

Abbreviations

MDM Mid-Day Meal
COREQ Consolidated Criteria for Reporting Qualitative Research

Supplementary Information

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Supplementary Material 1.

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Authors' contributions
N.R., A.W., K.G. and M.S. conceived the study and its original design. N.R., A.P., P.T. and M.K. collected the data. N.R., P.T. and M.K. analyzed the data. N.R. drafted the initial form and all revisions of this manuscript. All authors (N.R., P.T., M.K., A.P., M.S., K.G. and A.W.) reviewed and approved the final manuscript.

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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participate
The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Ethical Committee of Banaras Hindu University (Dean/2021/EC/2817). The procedures performed were in accordance with the ethical standards of the committee. Written informed consent was obtained from all respondents before commencement of the study.

Consent for publication
All the teachers and mothers gave written consent for publication. Written informed consent for publication of identifying/personal information was also obtained from the parents of primary school children.

Competing interests
The authors declare no competing interests.

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