



Effects of increased availability and economic incentives on preadolescents' healthier beverages choices: An experimental study

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ABSTRACT

This field experimental study examined how increased availability and economic incentives for healthier beverages affect preadolescents' actual healthier beverage choices in a real-world setting. In addition, the impact of preadolescents' descriptive norm towards healthier beverages, price awareness and parental restrictive rules regarding beverage consumption were explored. During the experiment, preadolescents could independently buy two beverages from an assortment with a total of eight beverages. A 2x2 between-subjects design was used, manipulating the presence of increased availability of healthier beverages and economic incentives (taxes for unhealthier beverages and subsidies for healthier beverages). A total of 305 preadolescents between 8 and 14 years old ($M = 10.18$, $SD = 1.74$) participated, each accompanied by one of their respective parents. Results showed that preadolescents were more likely to choose healthier beverages and perceived a higher descriptive norm towards healthier beverages when the assortment included increased relative availability of healthier beverages. Economic incentives and price awareness did not impact healthier beverage choices. Preadolescents were less likely to choose healthier beverages when parents reported higher levels of restrictive rules regarding beverage consumption. Results of the study suggest that increasing relative availability of healthier options could be a promising intervention strategy to support preadolescents in making healthier choices.

1. Introduction

Sugar-sweetened beverages (SSBs) are major sources of free sugars in children's and adolescents' diets. A typical SSB serving of soda (355 ml) contains 35.0–37.5 g of sugar (Malik & Hu, 2022). Children and adolescents worldwide consume on average 326 ml of SSBs per day (Ooi et al., 2022). SSB consumption at this level does not align with international recommendations to limit intake of free sugars to less than 10% (and preferably less than 5%) of total energy intake (WHO, 2020). In the Netherlands, drinking SSBs is seen as 'normal' by the majority of adolescents (71%) between 12 and 16 years old (Gemeente Amsterdam, 2022). The current trends in SSB intake are concerning, as consumption of SSBs has been linked with adverse health outcomes, including higher BMI and body weight in children and adults (Nguyen et al., 2023).

The transition from childhood to adolescence is seen as a unique life stage for establishing healthy dietary habits (Neufeld et al., 2022). Preadolescents gain autonomy and start making their own food and beverage choices (Bassett, Chapman, & Beagan, 2008). For example, preadolescents are able to make more decisions regarding what, when,

how much and where they choose to eat or drink (Reicks et al., 2015). As children move into adolescence, diet quality has been found to decrease (da Costa, Severo, Araújo, & Vilela, 2024). An important influencing factor on children's and adolescents' dietary choices is the food environment (Neufeld et al., 2022; Shaw et al., 2023). Choosing healthier beverage options can be difficult in the current food environment with abundant and growing availability and accessibility of energy-dense beverages at a relatively low cost (WHO, 2022b).

It has been argued that changing the environment in which individuals make beverage choices can help to support healthier choices (Atanasova et al., 2022). Two important environmental factors to promote healthier choices include increased availability of healthy options and economic incentives (e.g., subsidies for healthy options and/or taxations for unhealthy options) (von Philipsborn et al., 2020). Availability interventions seem effective to increase selection of healthier options (Hollands et al., 2019; Langfield, Marty, Inns, Jones, & Robinson, 2023; Marteau, Hollands, Pechey, Reynolds, & Jebb, 2022). The WHO has recommended fiscal policies (e.g., taxes and subsidies) as evidence-based policies to enable healthier choices (WHO, 2022a;

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2022b). An increasing number of countries use SSB taxation to promote healthy diets (WHO, 2023). There is a lack of knowledge on whether and how increased availability of healthier options and economic incentives influence beverage purchasing decisions among preadolescents (Shaw et al., 2023). It is important to recognize preadolescents as a distinct consumer group from adults, because their food or beverage decision-making processes differ (Mandal & Tripathi, 2022). As preadolescents' self-control ability is still under development, they are more prone to a bias towards unhealthy foods and find it harder to shift their attention away from these foods compared to adults (van Meer, Charbonnier, & Smeets, 2016; van Meer, van der Laan, Viergever, Adan, & Smeets, 2017).

Preadolescents' dietary behavior is influenced by interacting individual factors and physical and social environmental factors (Story, Neumark-Sztainer, & French, 2002). For example, parental influence on preadolescents' independent dietary choices remains important (Wang & Fielding-Singh, 2018). Examining individual factors and parental influence may further increase understanding of how and when physical environmental factors of increased availability and/or economic incentives affect preadolescents' purchasing decisions.

This experimental study examined how increased availability of healthier beverages and economic incentives (taxes for unhealthy beverages and subsidies for healthier beverages) impacted preadolescents' healthier beverage choices; see Fig. 1. In addition, the study explored preadolescents' perceptions of popular choices for healthier beverages (descriptive norms) as a possible mechanism underlying the effect of increased availability and investigated price awareness as a potential mechanism affecting the impact of economic incentives. Finally, the study examined whether restrictive rules set by parents about drinking certain beverages moderated the relationship between descriptive norms and healthier beverage choices. The study was designed to address knowledge gaps on how preadolescents make beverage purchase decisions when presented with assortments containing more healthy beverage options or varying prices. These insights could contribute to the development of effective environmental strategies to encourage healthier beverage choices among preadolescents.

2. Theoretical background & hypotheses

2.1. Effects of increased availability on healthier choices among preadolescents

A promising strategy to enhance healthier product choices among preadolescents involves availability interventions. Availability interventions change the assortment of products available to consumers (e.g., the number or range) within a specific physical micro-environment (Marteau et al., 2022). Categories of availability interventions include absolute availability (altering the overall number of options), relative availability (altering the proportion of a subset, e.g. healthier products,

while keeping the total number of options constant) and altering both absolute and relative availability simultaneously (Pechey, Hollands, Carter, & Marteau, 2020). For example, a relative availability intervention could involve replacing some sugary snacks with fruits or vegetables in order to create a higher proportion of healthier product options available to consumers. Interventions targeting the physical micro-environment have also been described as 'choice architecture' or 'nudge' interventions (Hollands et al., 2013). These approaches are based on dual process models stating that behavior (change) results from both conscious and non-conscious processes (Kremers et al., 2006). Interventions targeting the physical micro-environment mainly work through non-conscious psychological processes (Hollands et al., 2013).

Several pathways that could explain the impact of manipulating availability on individuals' behavior have been proposed, including prior preferences, social norms and visual attention (Pechey et al., 2020). Specifically, increasing the availability of healthier options could make it more likely that preferred beverage options are healthier, alter social norms to suggest enhanced intake and increase the likelihood that healthier beverages attract visual attention. Reviews found that reducing availability of targeted options (e.g., unhealthy options) reduced selection of these options and increased selection of healthier options (Hollands et al., 2019; Langfield et al., 2023; Marteau et al., 2022). There is limited evidence to suggest whether availability interventions impact food or beverage choices among children or adolescents. A review found that environmental interventions targeting availability could reduce SSB consumption among children and adolescents (von Philipsborn et al., 2020). However, low-certainty evidence was reported and beverage consumption patterns were based on self-reported measures. Few studies have examined effects of increased absolute availability (Bucher, Siegrist, & van der Horst, 2014; Stamos, Lange, & Dewitte, 2019) or relative availability (Kocken et al., 2012; van Kleef, Kremer, & van Trijp, 2020) on objective food or beverage choices among youth. As these previous studies assessed replica foods (Bucher et al., 2014) or sales data from vending machines or canteens which could not be linked to individual participants (Kocken et al., 2012; Stamos et al., 2019; van Kleef et al., 2020), it remains unclear how and why increased availability impacts actual individual beverage choices among preadolescents.

2.2. Impact of economic incentives on preadolescents' healthier choices

Economic incentives have been suggested as a useful strategy to promote healthier product choices (WHO, 2022a; 2022b). Economic incentives refer to factors that change costs, which motivates particular behavior relative to other behavior (Jensen et al., 2011). Economic incentives could be created by implementing healthy food or beverage subsidies and unhealthy food or beverage taxations (Niebylski, Redburn, Duhaney, & Campbell, 2015). As consumer demand is expected to respond inversely to price changes according to economic theory, taxes

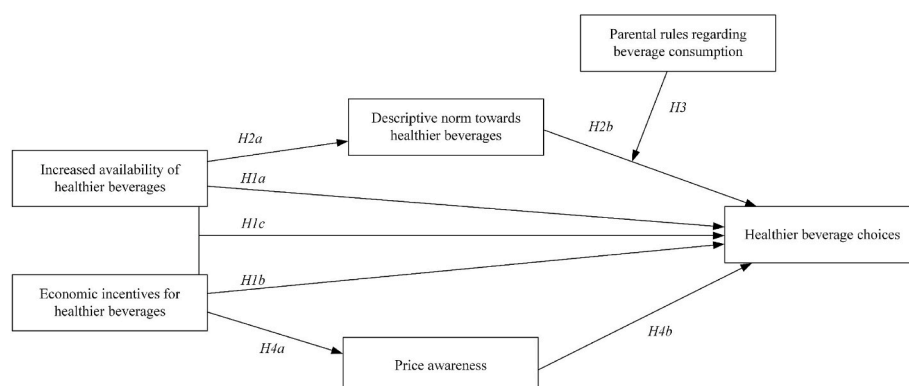


Fig. 1. Theoretical framework.

and subsidies could improve overall diets by consuming less (or more) of targeted foods (Powell & Chaloupka, 2009).

There is general consensus that taxes on SSBs are effective in reducing purchases and consumption of taxed beverages (Afshin et al., 2017; Andreyeva, Marple, Moore, & Powell, 2022; Barry et al., 2023; Hammaker et al., 2022; Redondo, Hernández-Aguado, & Lumberras, 2018; Sobhani & Babashahi, 2019). A recent review and meta-analysis found that subsidies for healthier foods (e.g., fruits and vegetables) were associated with increased purchases of these foods (Andreyeva et al., 2022). It has been suggested that combining taxes on unhealthy products and subsidies for healthy products is the most effective approach to improve dietary behaviors (Cobiac, Tam, Veerman, & Blakely, 2017; Niebylski et al., 2015).

There is limited evidence on how economic incentives (e.g., taxes and subsidies) impact product choices among preadolescents (Hargreaves et al., 2022). A review reported that economic incentives appeared to effectively promote healthy food choices (e.g., fruit and vegetables) and reduce energy-rich food and beverage choices at school. Previous studies were scarce and mainly focused on food choices among children older than 10–12 years (Jensen et al., 2011). Mixed findings have been reported for the influence of decreased prices (e.g., subsidies) on preadolescents' food choices (Hartmann, Cash, Yeh, Landwehr, & McAlister, 2017; Landwehr & Hartmann, 2024; Landwehr, Hartmann, Cash, & Yeh, 2023; Salvy, Kluczynski, Nitecki, & O'Connor, 2012). In general, results from previous studies suggest that preadolescents are sensitive to prices and are likely to choose more healthy options when taxes for unhealthy options and subsidies for healthy options are used.

It has been suggested that the impact of economic incentives may depend on the availability of healthy and unhealthy options (Jensen et al., 2011). For example, a study found that only the combination of price changes, labeling and increased availability of healthier options was effective in increasing healthier beverage sales at schools (Kocken et al., 2012). Economic incentives (taxes and subsidies) may affect preadolescents' healthier beverage choices more strongly when the assortment includes increased availability of healthier beverages.

2.3. The role of descriptive norms towards healthier beverages

Preadolescents' perceptions of popular choices for healthier beverages may serve as descriptive norms underlying the effect of increased availability (Pechey et al., 2021). Descriptive norms include beliefs about what most others do in a specific setting (Cialdini, Reno, & Kallgren, 1990; Reno, Cialdini, & Kallgren, 1993). Altering available products could imply a social norm regarding the acceptance of specific products (e.g., healthier products), which may influence selection and consumption (Hollands et al., 2019). A study among adults suggested that increased availability of healthier options leads to healthier choices through a stronger descriptive norm towards healthier options (Pechey et al., 2021).

It has been found that descriptive norms towards healthy eating are related to higher intentions to eat healthily and healthy snack choices among children (Hang, Davies, & Schüring, 2020). Descriptive norms on drinking SSBs have been associated with higher SSB intake among children, adolescents and young adults (Calabro, Kemp, & Prichard, 2023). Similarly, preadolescents who believe that most others choose healthier beverages may be more likely to choose healthier beverages themselves.

2.4. Influence of parental rules regarding beverage consumption

Parental rules about beverage consumption refer to limits and expectations regarding beverage intake and purchases, for example when and how much preadolescents are allowed to drink SSBs. It has been argued that setting rules or limits supports children's autonomy in food decisions (Balantekin et al., 2020). A qualitative study found that parents use rules and expectations to influence food choices during

independent eating occasions, for example by having rules about specific foods and portion sizes (Gunther et al., 2019). Previous studies on the association between parental rules and preadolescents' consumption of unhealthy or healthy foods and beverages found contradictory results (e.g., Fleary & Ettienne, 2019; McCormick et al., 2021; Monroe-Lord et al., 2022; van de Gaar, van Grieken, Jansen, & Raat, 2017; Yee, Lwin, & Ho, 2017).

Similar mixed findings have been reported for the relationship between parental food rules or expectations and adolescents' independent food and beverage choices (e.g., without presence of parents) (Reicks et al., 2023; Wang & Fielding-Singh, 2018). A possible explanation for these inconsistent findings includes that parental rules were differentially conceptualized and operationalized in previous studies (e.g., restriction, limits or expectations) (Vaughn et al., 2016).

It has been found that adolescents with food rules at home seem to feel more positively and perceive more parental approval when they choose healthy foods (Wang & Fielding-Singh, 2018). Similarly, preadolescents may be more likely to conform to perceived descriptive norms towards healthier beverages if their parents have restrictive rules about beverage consumption, as choosing healthy options may shape positive feelings.

2.5. The role of price awareness

A possible mechanism underlying the impact of economic incentives on healthier beverage choices includes preadolescents' price awareness. Price is seen as a key determinant in food and beverage purchasing decisions among youth (Devine, Hill, & Gallagher, 2023). Preadolescents seem responsive to price and price changes. For example, it has been found that preadolescents are more likely to choose foods with lower prices (Hartmann et al., 2017; Landwehr et al., 2023), suggesting that preadolescents seem to prefer cheaper options. In a qualitative study, adolescents (11–13 years old) mentioned that increased prices of unhealthy foods would discourage price-conscious adolescents from eating unhealthily (Gilmour, Gill, & Loudon, 2020). Another study found that 70% of children 10–12 years old agreed that price increases on soft drinks would make them purchase less soft drinks (Jensen et al., 2012).

It has been argued that economic incentives influence individual's decision processes, for example through their awareness (Jensen et al., 2011). As such, economic incentives by using taxes and subsidies may elicit higher levels of price awareness among preadolescents. Being more aware of prices due to taxes or subsidies may influence healthy choices by reassessing existing unhealthy preferences (Hawkes et al., 2015). Higher levels of price awareness may encourage preadolescents to reassess their preferences and make cheaper and healthier choices.

3. Methods

3.1. Experimental design

This field experimental study took place in a science museum for youth, within a real-world context. A 2x2 between-subjects design was used to create four conditions that varied in increased availability of healthier beverages (absent versus present) and economic incentives for healthier beverages (absent versus present), see Fig. 2. Preadolescents could buy two beverages in a simulated store from an assortment with a total of eight beverages. The beverages were categorized into healthier or unhealthier options based on guidelines from the Dutch Nutrition Centre (Dutch Nutrition Centre). Healthier beverages contained less than 4 kcal/100 ml, which are considered as 'daily choices' to consume. Unhealthier beverages contained more than 4 kcal/100 ml, which are considered as 'weekly choices' to consume.

Increased availability of healthier beverages was manipulated by changing the relative availability of healthier beverages in the assortment. Both assortments included four similar beverages (two healthier

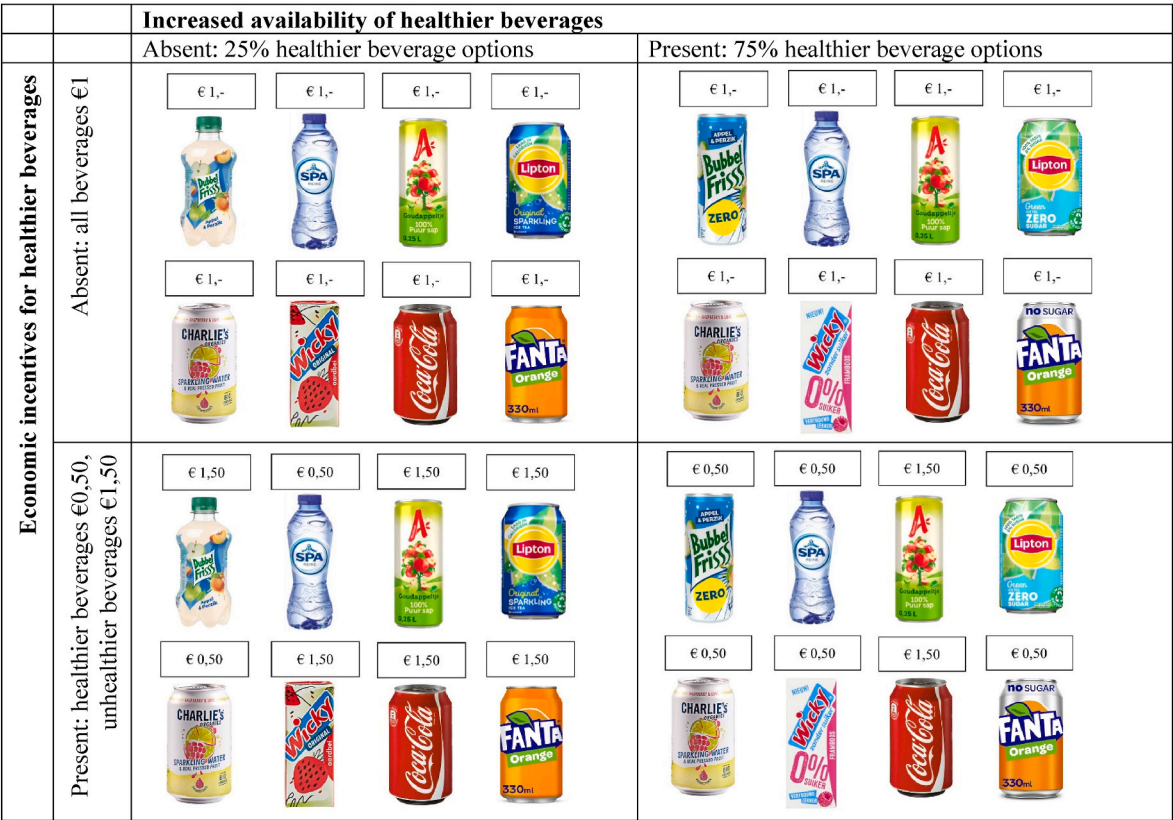


Fig. 2. Overview of experimental design.

beverages and two unhealthier beverages). The remaining four beverages were either unhealthier (increased availability absent) or healthier (increased availability present), see Table 1. When increased availability was absent, the product assortment contained 25% of healthier beverage options (2 beverages) and 75% of unhealthier beverage options (6 beverages). These proportions resembled the assortment of unhealthy products in Dutch supermarkets, as 79% of products in Dutch supermarkets does not align with national dietary guidelines (Poelman et al., 2021). When increased availability of healthier beverages was present, the assortment proportions of healthier and unhealthier beverage options changed, including 75% of healthier beverage options (6 beverages) and 25% of unhealthier beverage options (2 beverages). Previous studies used similar proportions of healthier and less healthy options

Table 1
Experimental stimuli with healthier (≤ 4 kcal/100 ml) and unhealthier (> 4 kcal/100 ml) beverages.

Beverage	Calories per 100 ml (kcal/100 ml)	Amount (ml)
Spa Reine Water ^a	0	330
Charlie's Sparkling water raspberry & lime ^a	0	330
BubbelFriss Zero Apple & Peach ^b	4	250
DubbelFriss Apple & Peach	23	275
Fanta Orange Zero ^b	3	330
Fanta Orange Regular	23	330
Wicky sugar free fruit drink raspberry ^b	1	200
Wicky original fruit drink strawberry	24	200
Lipton Ice Tea Green Zero ^b	1	330
Lipton Ice Tea Sparkling Original	20	330
Coca Cola Regular ^a	42	330
Goudappeltje 100% pure juice ^a	44	250

^a Beverages available in both assortments.

^b Healthier variant of beverage.

available (Langfield et al., 2023). To prevent confounding effects due to brand or flavour preferences, unhealthier beverages were replaced with healthier variants from the same brand. For example, 'Fanta Orange Regular' was replaced with 'Fanta Orange Zero'. The beverages were placed in a display rack with name tags and prices (see Fig. 3). The position of each beverage brand in the display rack remained the same across conditions.

Economic incentives for healthier beverages were manipulated by changing the price of the beverages. Either the same price for all beverages (€1) was used (economic incentives for healthier beverages absent) or subsidies for healthier beverages (€0,50) and taxes for unhealthier beverages (€1,50) of 50% were applied (economic incentives for healthier beverages present). The tax and subsidy percentages were based on previous recommendations using these policies in tandem with a minimum of 10–15% (Niebylski et al., 2015). Considering the relatively young target group (at least 8 years old), prices of the beverages were rounded to half numbers to ease calculating the price of two beverages. As the museum did not allow the use of actual money, preadolescents received breakable coins to simulate paying with cash in the store.

3.2. Procedure

Data collection took place in a Dutch museum in science and technology for youth (NEMO) during the May holiday of 2022 (April 23 to May 8). The experimental study was part of Science Live, the long-standing research programme of NEMO that enables scientists to carry out real research using NEMO visitors as volunteers. Science Live is partially funded by KNAW. The Social Sciences Ethics Committee of Wageningen University & Research approved the research project.

Preadolescents visiting the museum were recruited by asking if they would like to join a scientific experiment in which they could test their knowledge on SSBs. Preadolescents were able to participate if they were



Fig. 3. Preadolescent choosing beverages in the simulated shop.

aged between 8 and 14 years old, spoke Dutch and if one of their parents was present and willing to participate as well. Research assistants explained the study and preadolescents and their parents were asked to provide informed consent. Due to practical constraints in setting up the simulated store, specific sessions (morning or afternoon) were randomly assigned to experimental conditions. Preadolescents and their accompanying parent were automatically assigned to the condition linked to that session.

Preadolescents and parents who were willing to participate were separated into different rooms to ensure that preadolescents' participation was not influenced by their parent. Parents were asked to complete an online questionnaire. Preadolescents were individually guided to a simulated store. They were given €3 in breakable coins of simulated money and were told that they could use it to purchase two beverages for themselves in the store. It was explained that preadolescents could keep the products they purchased, as well as the change. Preadolescents could choose the same beverage more than once. After selecting the beverages of their choice, preadolescents could check out with the research assistant. The beverages were placed in a bag and were handed over to preadolescents, together with the change. Afterwards, preadolescents were asked to complete an online questionnaire in a different room. Research assistants were present to answer potential questions.

After filling out the questionnaire, preadolescents' knowledge of sugar content in beverages was measured by completing a sugar cube quiz. During this quiz, five beverages (Coca Cola Regular, DubbelFriss Apple & Peach, AA drink energy, Crystal Clear sparkling lemon flavour and Lipton Ice Tea green) and five ziplock bags containing different amounts of sugar cubes were randomly displayed on a table (see Fig. 4). Preadolescents were asked to guess the amount of sugar cubes in these beverages by matching each beverage with the corresponding ziplock



Fig. 4. Sugar cube quiz to measure knowledge of sugar content in beverages.

bag without looking at the nutritional labels. After completing the quiz, research assistants recorded the answers and gave feedback about preadolescents' performance. In addition, preadolescents received a certificate for participating.

3.3. Participants

During the two-week duration of the study, efforts were made to recruit as many participants as possible. A total of 305 preadolescents between 8 and 14 years old participated in the study, each accompanied by one of their respective parents. Preadolescents were on average 10.18 years old ($SD = 1.74$) and approximately half of the sample were girls (48.2%). The average age among parents was 42.73 ($SD = 5.34$) and 60.3% of participating parents were female. The majority of parents were highly educated (72.7%).

3.4. Preadolescent measures

3.4.1. Healthier beverage choices

Preadolescents' actual beverage choices were recorded and categorized as relatively healthy (<4 kcal/100 ml) or relatively unhealthy (>4 kcal/100 ml) based on guidelines from the Dutch Nutrition Centre (Dutch Nutrition Centre). The total number of relatively healthier beverages chosen was calculated (0, 1 or 2 healthier beverages). Based on previous research, this variable was treated as ordinal (Bryan et al., 2016; Wang & Fielding-Singh, 2018).

3.4.2. Descriptive norm towards healthier beverages

A picture ranking task was used in the questionnaire to measure preadolescents' descriptive norm towards healthier beverages. Preadolescents were shown 8 pictures of beverages from the assortment they were presented with in the simulated shop. They were asked to rank-order pictures of the beverages from most to least often chosen beverage by other children of their age. For example, the top ranked beverage (first place) represented the beverage preadolescents thought others of their age would choose most often whereas the last place represented the beverage they thought others would choose least often. This item was based on a previous study (Raghoebar, Van Kleef, & De Vet, 2020) and adapted by ranking the beverages to make it more tangible for the target group. The two highest ranked beverages (first and second place) were used as an indicator of preadolescents' descriptive norm towards healthier beverages by categorizing them as relatively healthy or relatively unhealthy. The sum of selected relatively healthier beverages was calculated (0, 1 or 2 healthier beverages), with higher numbers indicating a higher perceived norm towards healthier

beverages. This variable was treated as ordinal.

3.4.3. Price awareness

Two items were used to measure preadolescents’ price awareness. The items included “The prices of the beverages led me to reflect on my choices for a moment” and “If the prices of the beverages were different I would have chosen something else”. A 5-point scale was used, ranging from strongly disagree (0) to strongly agree (4). The items were correlated ($r = 0.48, p < .001$) and Spearman-Brown coefficient was 0.65. An average score was calculated to indicate preadolescents’ level of price awareness.

3.4.4. Relative healthy beverage consumption

Preadolescents’ consumption of different healthy and unhealthy beverages was measured using 8 items. The items were based on a previous study (van Nee, van Kleef, & van Trijp, 2021). Healthy beverage categories included water or tea, milk and low sugar or sugar-free drinks. Unhealthy beverage categories included regular soft drinks, non-carbonated soft drinks, fruit juice, lemonade and sports/-energy drinks. Preadolescents were asked how often they consumed these beverages on a 5-point scale (never, almost never, sometimes, often, very often). Mean scores were calculated for healthy and unhealthy beverage consumption. A healthy beverage consumption ratio was calculated to indicate preadolescents’ relative healthy beverage consumption. Based on a similar approach in a previous study (Ding et al., 2012), the mean consumption of healthy beverages was divided by the mean consumption of unhealthy beverages. A ratio of more than 1 represented more consumption of healthy beverages relative to consumption of unhealthy beverages. A ratio of less than 1 indicated more consumption of unhealthy beverages relative to consumption of healthy beverages.

3.4.5. Food or beverage purchasing

Preadolescents were asked about the frequency of purchasing foods or beverages independently. One item on a 4-point scale was used (never (0), approximately once per month (1), approximately once per week (2) or almost every day (3)).

3.4.6. Knowledge of sugar content in beverages

Knowledge of sugar content in beverages was measured during the sugar cube quiz. During this quiz, preadolescents were asked to match five beverages with ziplock bags containing different amounts of sugar cubes. The number of correct matches between beverages and the corresponding amount of sugar cubes was recorded (0–5). A higher score indicated more knowledge of sugar content in beverages.

3.4.7. Assortment evaluation

Two items were used to measure evaluations about the healthiness and realism of the beverage assortment. Items included “The beverages I was allowed to choose from looked healthy” and “The beverages I was allowed to choose from looked normal”. A 5-point scale was used ranging from strongly disagree (0) to strongly agree (4).

3.5. Parent measures

3.5.1. Parental rules regarding beverage consumption

Parental rules regarding preadolescents’ beverage consumption were measured using 9 items (see Table 2 for an overview of the items). The items were based on previous studies (Birch et al., 2001; Davison et al., 2018; Gevers, Raaijmakers, et al., 2015) and adapted by focusing on beverages instead of snacks and using a 5-point scale ranging from strongly disagree (0) to strongly agree (4) to measure the extent to which parents agreed with the statements. Cronbach’s α was 0.74. An average score was calculate to indicate the level of parental rules regarding preadolescents’ beverage consumption.

Table 2
Parental rules regarding beverage consumption.

Items	Source
My child is not allowed to consume certain types of beverages (e.g. energy drinks or sugar-sweetened beverages)	Restrictive food rules questionnaire (Gevers, Raaijmakers, et al., 2015)
My child is only allowed to consume sugar-sweetened beverages on special occasions (e.g. birthdays or parties)	
My child is only allowed to consume sugar-sweetened beverages on weekends	
On certain occasions, my child is only allowed to consume water, tea or unsweetened dairy	
If my child consumes sugar-sweetened beverages, I limit the amount	Parenting around Snacking Questionnaire (Davison et al., 2018)
I have rules about what types of beverages are allowed at dinner	
My child is allowed to drink whatever she wants (reversed coding)	
I have to be sure that my child does not consume too many unhealthy beverages	Child Feeding Questionnaire (Birch et al., 2001)
If I did not guide or regulate my child’s drinking, she would consume too many unhealthy beverages	

3.5.2. Relative healthy beverage consumption at home

To measure relative healthy beverage consumption at home, the same 8 items from the preadolescent questionnaire were used. Parents were asked how often different healthy beverage categories (water or tea, milk and low sugar or sugar-free drinks) and unhealthy beverage categories (regular soft drinks, non-carbonated soft drinks, fruit juice, lemonade and sports/energy drinks) were consumed in their home. Answer categories of the 5-point scale included never, almost never, sometimes, often and very often. Mean scores were calculated for healthy and unhealthy beverage consumption at home. Consequently, the mean consumption of healthy beverages was divided by the mean consumption of unhealthy beverages at home. A ratio of more than 1 indicated more consumption of healthy beverages relative to unhealthy beverages at home. A ratio of less than 1 indicated more consumption of unhealthy beverages relative to healthy beverages at home.

3.6. Data analysis

Descriptive statistics and correlation coefficients were calculated. Pearson’s correlations were used for continuous variables and Spearman’s rank correlations were used for ordinal variables. Randomization to conditions was checked using one-way ANOVAs and Chi-square tests. Ordinal logistic regressions were performed to examine how increased availability of healthier beverages and economic incentives affected preadolescents’ healthier beverage choices. Predicted probabilities were calculated to ease interpretation. A Chi-square test was used to test differences in frequencies of specific beverages. The potential mediating roles of descriptive norm towards healthier beverages and price awareness were explored by performing mediator variable models and dependent variable models. Indirect effects were calculated using nonparametric bootstrap confidence intervals with the percentile method. Mediation analyses were performed on complete cases using listwise deletion. The potential moderating influence of parental rules regarding beverage consumption was investigated by calculating the interaction effect between descriptive norms towards healthier beverages and parental rules. This interaction effect was part of the dependent variable model for descriptive norm towards healthier beverages using ordinal logistic regression. Continuous independent variables were standardized. Gender was included as a control variable. Model assumptions of proportional odds and absence of multi-collinearity were checked, indicating no violations.

The data were analysed with R version 4.3.1 (R Core Team, 2023)

and RStudio version 2023.6.1.524 (Posit team, 2023). Used R packages included 'psych' for descriptive statistics and correlations, 'ggplot2' to create plots, 'ggmosaic' for mosaic plots, 'MASS' for ordinal logistic regressions and 'mediation' to test indirect effects.

4. Results

4.1. Descriptives

Descriptive statistics for study variables across conditions are shown in Table 3. No differences were found between conditions (p 's > 0.05), indicating that randomization had been successful. Preadolescents' perceived level of healthiness regarding the beverage assortment was similar across conditions. Approximately half of preadolescents (46.5%) disagreed to some extent that the beverages from the assortment looked healthy ($Mdn = 2$). Most preadolescents perceived the assortment as realistic ($Mdn = 3$). During the sugar cube quiz, preadolescents were on average able to correctly match half of the beverages with the corresponding amount of sugar cubes ($M = 2.71$, $SD = 1.60$). Approximately one third of preadolescents chose zero healthier beverages (34.5%), whereas 40.5% chose one healthier beverage and 25.0% chose two healthier beverages. Fig. 5 shows a mosaic plot with percentages of healthier beverage choices in each condition. Perceived descriptive consumption norm measured zero healthier beverages for 38.8% of preadolescents, one healthier beverage for 53.0% and two healthier beverages for 8.2%.

The majority of preadolescents purchased foods or beverages never (38.8%) or once per month (35.5%). A total of 21.4% purchased foods or beverages once per week and 4.3% purchased foods or beverages almost every day. On average, more healthy beverages relative to unhealthy beverages were consumed among preadolescents ($M = 1.29$, $SD = 0.44$)

and at home (parent-reported) ($M = 1.55$, $SD = 0.47$).

Correlation coefficients between study variables are shown in Table 4. Preadolescents who chose more healthier beverages perceived a higher descriptive healthy norm, consumed relative more healthy beverages and had less parenting rules regarding beverage consumption. Girls were more likely to choose healthier beverages than boys.

4.2. Effects of increased availability and economic incentives on healthier beverage choices

Table 5 shows results of the ordinal logistic regression explaining preadolescents' healthier beverage choices, controlling for gender. H1a was confirmed, as a significant effect of increased availability of healthier beverages was found ($p < .001$). As shown in Fig. 6, preadolescents had a higher probability of choosing one healthier beverage (0.47 versus 0.32) or two healthier beverages (0.47 versus 0.03) if increased availability was present. An additional analysis was conducted to examine potential differences in specific beverage choices. Specific beverages or healthier variants of those beverages were equally chosen if increased availability was absent or present ($\chi^2(7) = 6.17$, $p = .52$), see Fig. 7.

The main effect of economic incentives and the interaction effect between increased availability and economic incentives were not significant. Therefore, H1b and H1c were not supported.

4.3. Influence of descriptive norms towards healthier beverages and parental rules

H2a was confirmed, as increased availability was significantly associated with preadolescents' descriptive norm towards healthier beverages ($p < .001$), see Table 6. Preadolescents were more likely to

Table 3
Descriptive statistics of study variables across conditions.

		No increased availability of healthier beverages		Increased availability of healthier beverages		
	Total (n = 304)	No economic incentives for healthier beverages (n = 76)	Economic incentives for healthier beverages (n = 75)	No economic incentives for healthier beverages (n = 80)	Economic incentives for healthier beverages (n = 73)	Test statistics
Variable	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	
<i>Preadolescents</i>						
Age (years)	10.18 (1.74)	10.05 (1.70)	10.05 (1.66)	10.44 (1.85)	10.18 (1.76)	$F(3, 300) = 0.85, p = .47$
Gender: Girls	48.2%	51.4%	45.1%	44.0%	53.0%	$\chi^2(6) = 6.99, p = .32$
Price awareness	1.69 (1.15)	1.72 (1.05)	1.83 (1.26)	1.71 (1.07)	1.49 (1.19)	$F(3, 300) = 1.10, p = .35$
Relative healthy beverage consumption	1.29 (0.44)	1.23 (0.44)	1.24 (0.41)	1.30 (0.32)	1.41 (0.56)	$F(3, 297) = 2.57, p = .06$
Food or beverage purchasing	1.91 (0.88)	1.83 (0.94)	1.95 (0.88)	2.02 (0.86)	1.84 (0.82)	$F(3, 300) = 0.89, p = .44$
Knowledge of sugar content in beverages	2.71 (1.60)	2.78 (1.60)	2.72 (1.65)	2.75 (1.62)	2.60 (1.57)	$F(3, 300) = 0.17, p = .92$
Perceived healthiness of assortment	1.54 (0.98)	1.49 (0.87)	1.39 (0.91)	1.65 (1.02)	1.62 (1.11)	$F(3, 297) = 1.14, p = .33$
Perceived realism of assortment	2.64 (0.99)	2.83 (0.92)	2.67 (1.03)	2.54 (0.94)	2.51 (1.07)	$F(3, 298) = 1.56, p = .19$
<i>Parents</i>						
Age	42.73 (5.34)	42.48 (6.34)	42.63 (5.39)	43.17 (4.98)	42.52 (4.44)	$F(3, 210) = 0.21, p = .89$
Gender: Female	60.3%	58.11%	57.33%	64.56%	61.11%	$\chi^2(3) = 1.04, p = .79$
Highest educational level						
Low	5.7%	4.05%	5.33%	5.06%	8.33%	$\chi^2(6) = 2.51, p = .87$
Middle	21.7%	22.93%	25.33%	20.25%	18.06%	
High	72.7%	72.97%	69.33%	74.68%	73.61%	
Parental rules regarding beverage consumption	2.89 (0.59)	2.91 (0.56)	2.92 (0.52)	2.89 (0.66)	2.83 (0.61)	$F(3, 296) = 0.32, p = .81$
Relative healthy beverage consumption at home	1.55 (0.47)	1.59 (0.50)	1.50 (0.35)	1.52 (0.45)	1.61 (0.55)	$F(3, 292) = 1.02, p = .38$

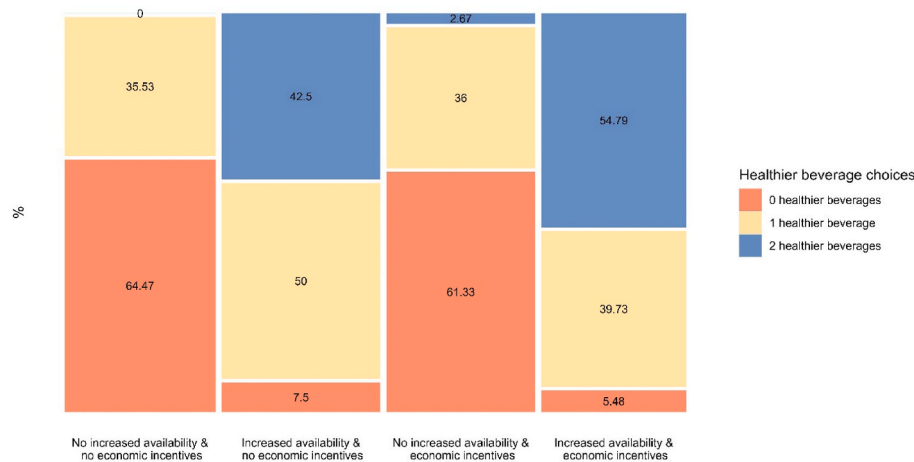


Fig. 5. Percentages of healthier beverage choices across conditions.

Table 4
Correlation coefficients between study variables.

	1 ^a	2 ^a	3	4	5	6	7	8	9	10	11	12	13
1: Healthier beverage choices ^a	—												
2: Descriptive norm towards healthier beverages ^a	0.53 ^c	—											
3: Price awareness	−0.09	0.00	—										
4: Relative healthy beverage consumption	0.16 ^c	0.14 ^b	−0.09	—									
5: Food or beverage purchasing	0.04	0.05	0.27 ^c	−0.08	—								
6: Knowledge of sugar content in beverages	−0.02	−0.04	0.07	−0.10	0.16 ^b	—							
7: Age preadolescent	0.08	−0.04	0.17 ^c	0.13 ^b	0.43 ^c	0.26 ^c	—						
8: Gender preadolescent	0.13 ^b	−0.01	−0.13 ^b	0.12 ^b	−0.19 ^c	−0.02	−0.10	—					
9: Parental rules regarding beverage consumption	−0.14 ^b	−0.05	−0.02	−0.02	−0.15 ^b	−0.04	−0.20 ^c	−0.01	—				
10: Relative healthy beverage consumption at home	0.04	0.03	−0.12 ^b	0.40 ^c	−0.05	0.00	−0.04	0.09	0.13 ^b	—			
11: Age parent	0.03	0.02	0.16 ^b	0.17 ^b	0.16 ^b	0.07	0.29 ^c	−0.14	0.05	0.25 ^c	—		
12: Gender parent	0.03	0.06	−0.01	−0.04	−0.01	0.10	−0.05	0.06	0.14 ^b	0.04	−0.27 ^c	—	
13: Highest education level parent ^a	0.00	−0.02	−0.11	0.19 ^c	−0.14 ^b	−0.11	−0.05	0.10	0.23 ^c	0.35 ^c	0.29 ^c	0.00	—

Note.
^a Spearman’s rank correlation coefficient due to ordinal level.
^b $p < .05$.
^c $p < .01$.

Table 5
Ordinal logistic regression explaining preadolescents’ healthier beverage choices.

Variable	Coef.	SE	t	p
Intercept 0 healthier beverages 1 healthier beverage	1.04	0.29	3.62	<0.001
Intercept 1 healthier beverage 2 healthier beverages	4.01	0.41	9.68	<0.001
Gender: Girl	0.65	0.25	2.63	0.01
Increased availability of healthier beverages: Present	3.32	0.42	7.93	<0.001
Economic incentives for healthier beverages: Present	0.18	0.35	0.51	0.61
Increased availability of healthier beverages * Economic incentives for healthier beverages	0.37	0.49	0.76	0.45

Note. Proportional odds assumption holds (Brant test (Omnibus Test) $\chi^2(4) = 2.62$, $p = .62$). Results remained consistent when preadolescents’ relative healthy beverage consumption was included as an additional covariate.

perceive a descriptive norm towards one or two healthier beverages (versus zero healthier beverages) if increased availability of healthier beverages was present. H2b was not supported, as descriptive norms towards healthier beverages were not associated with healthier beverage choices. No indirect effect was found, indicating that descriptive norms towards healthier beverages did not mediate the relationship between increased availability and healthier beverage

choices. H3 was not supported, as interaction effects between parental rules regarding beverage consumption and descriptive norm towards healthier beverages were not significant (see Table 6). In contrast, a significant main effect was found for parental rules ($p = .01$). Higher scores on parental rules regarding beverage consumption were associated with a decrease in the likelihood of choosing one or two healthier beverages.

4.4. Influence of price awareness

As shown in Table 7, preadolescents’ price awareness was not associated with economic incentives for healthier beverages or healthier beverage choices. Therefore, H4a and H4b were not supported.

5. Discussion

This experimental study examined the impact of increased availability of healthier beverages and economic incentives (taxes for unhealthier beverages and subsidies for healthier beverages) on preadolescents’ actual healthier beverage choices. The study contributes to previous literature by exploring effects and underlying mechanisms of varying assortments and prices on preadolescents’ independent beverage purchase decisions. Specifically, the study advances the field by using an experimental design within a real-world setting, measuring

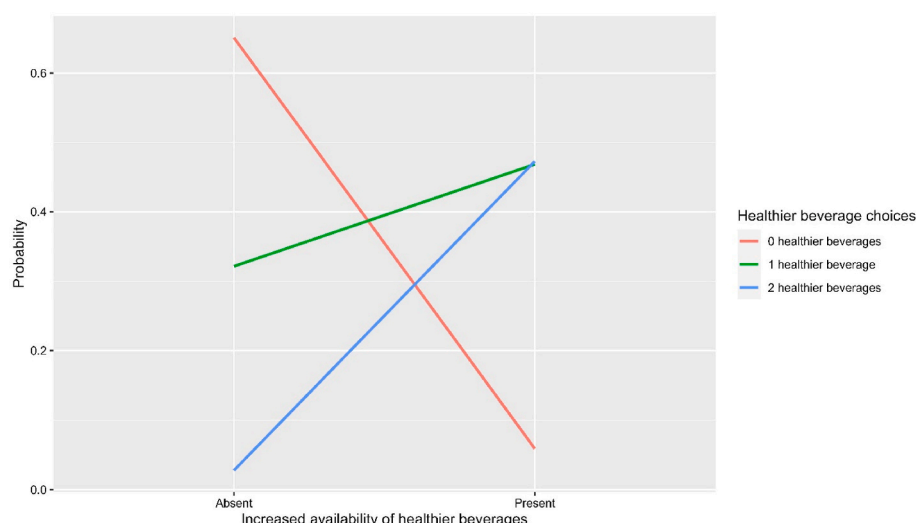


Fig. 6. Predicted probabilities of healthier beverage choices.

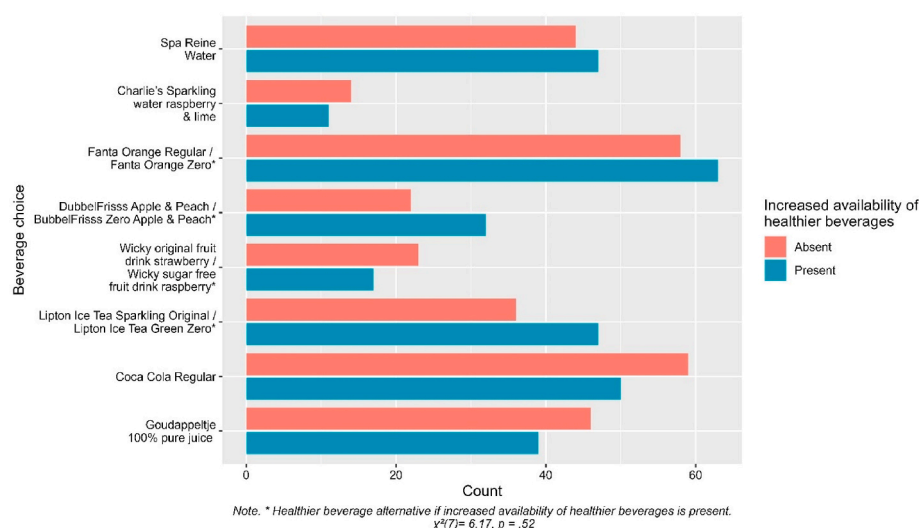


Fig. 7. Frequencies of chosen beverages with and without increased availability of healthier beverages.

actual beverage purchases and collecting both preadolescent- and parent-reported data. As such, the study enhanced understanding of physical and social environmental factors, as well as individual factors influencing healthier beverage choices among preadolescents. Results show that preadolescents were more likely to choose healthier beverages if the availability of healthier beverages was increased. No support was found for the effect of economic incentives, suggesting that taxes and subsidies did not affect preadolescents' healthier beverage choices.

The study found that increased availability of healthier beverages influenced preadolescents' healthier beverage choices. When the assortment of healthier beverage options changed from 25% to 75%, preadolescents were more likely to choose one or two healthier beverages versus zero healthier beverages. Results are in line with reviews reporting positive effects of increased relative availability interventions, which have been mainly conducted among adults (Hollands et al., 2019; Langfield et al., 2023; Marteau et al., 2022). Studies exploring the effects of an increased relative healthier assortment on preadolescents' choices are scarce (Kocken et al., 2012; van Kleef et al., 2020). This study adds further support for the effectiveness of increased relative availability interventions on actual healthier choices among preadolescents. Preadolescents perceived the healthiness of the assortment similarly across conditions. Specific beverages or healthier variants of those beverages

were equally chosen regardless of the presence of increased availability. These results suggest that preadolescents may not notice changes in the healthiness of available beverage options. They seem to choose their preferred option, regardless whether the beverage is a regular or healthier variant. As such, creating a healthier food environment by increasing the relative availability of healthier options may help to support healthier choices (Atanasova et al., 2022).

Increased availability of healthier beverages was associated with a stronger descriptive norm towards healthier beverages. Preadolescents confronted with assortments that contained more healthier options thought that others of their age would typically choose one or two healthier beverages versus zero healthier beverages. No support was found for a mediating role of descriptive norm towards healthier beverages in explaining healthier beverage choices. As the study was conducted with preadolescents visiting a museum, participants did not know each other. In addition, preadolescents were individually invited to the simulated store to purchase beverages without the presence of other peers. It has been found that the influence of social norms on adolescents' and young adults' food intake depends on the extent to which one identifies with the norm referent group (Stok, de Vet, de Ridder, & de Wit, 2016). Due to the setting with unfamiliar peers and anonymity of their beverage choices in the simulated store, it could

Table 6
Mediation analysis predicting healthier beverage choices via descriptive norms and parental rules.

Predictor variable	Coef.	SE	t	p
DV: Descriptive norm towards healthier beverages (Mediator variable model)				
Intercept 0 healthier beverages 1 healthier beverage	0.96	0.24	4.06	<0.001
Intercept 1 healthier beverage 2 healthier beverages	5.95	0.51	11.58	<0.001
Increased availability of healthier beverages: Present	4.16	0.46	9.07	<0.001
DV: Healthier beverage choices (Dependent variable model)				
Intercept 0 healthier beverages 1 healthier beverage	1.16	0.26	4.51	<0.001
Intercept 1 healthier beverage 2 healthier beverages	4.14	0.40	10.44	<0.001
Increased availability of healthier beverages: Present	3.15	0.42	7.49	<0.001
Descriptive norm: 1 versus 0 healthier beverages	0.51	0.36	1.42	0.16
Descriptive norm: 2 versus 0 healthier beverages	0.69	0.63	1.10	0.27
Parental rules regarding beverage consumption	−0.53	0.20	−2.61	0.01
Descriptive norm: 1 versus 0 healthier beverages ^a Parental rules regarding beverage consumption	0.40	0.27	1.48	0.14
Descriptive norm: 2 versus 0 healthier beverages ^a Parental rules regarding beverage consumption	0.71	0.49	1.44	0.15

	0 healthier beverages	1 healthier beverage	2 healthier beverages
ACME [95% CI]	−0.07 [−0.19 – 0.04]	0.06 [−0.03 – 0.16]	0.01 [−0.00 – 0.04]
ADE [95% CI]	−0.57 [−0.66 to −0.47] ^a	0.21 [0.09–0.31] ^a	0.36 [0.24–0.51] ^a
Total effect [95% CI]	−0.59 [−0.67 to −0.51] ^a	0.15 [0.05–0.25] ^a	0.44 [0.35–0.53] ^a

Note.
^a $p < .05$. Both models are adjusted for gender. The inclusion of pre-adolescents' relative healthy beverage consumption as an additional covariate produced similar results. Continuous independent variables were standardized. ACME = average causal mediation effect (indirect effect), ADE = average direct effect. Nonparametric bootstrap confidence intervals with the percentile method used for variance estimation (1000 simulations), used sample size = 280.

be that preadolescents in the current study did not identify strongly with the norm referent group. If people do not feel connected to the referent group or have no aspiration to be part of it, descriptive norms may have limited influence on behavior (Stok et al., 2016). This may explain why descriptive norm towards healthier beverages did not influence pre-adolescents' beverage choices.

Preadolescents' healthier beverage choices were not influenced by economic incentives (taxes for unhealthier beverages and subsidies for healthier beverages), nor by the interaction between increased availability of healthier beverages and economic incentives. The results showed that a 50% subsidy on healthier beverages and a 50% tax on unhealthier beverages did not increase healthier beverage choices among preadolescents. Similarly, there is no consistent evidence that SSB taxes worldwide have incentivized increased purchases of healthier beverages or decreased consumption of SSB, suggesting that the overall effectiveness of SSB taxes in achieving substantial behavioral change and improving health outcomes remains uncertain (Kiesel, Lang, & Sexton, 2023). The demand for sugary drinks among young people may be relatively inelastic due to their popularity, which may suggest that price increase could have little effect. It has been suggested that price interventions could differentially affect children's snack choices as children are a heterogeneous consumer group (Landwehr et al., 2023). Results are in line with a recent study reporting that price did not

Table 7
Mediation analysis predicting healthier beverage choices via price awareness.

Predictor variable	Coef.	SE	t	p
DV: Price awareness (Mediator variable model)				
Intercept	1.86	0.12	15.70	<0.001
Economic incentives: Present	−0.06	0.14	−0.43	0.67
DV: Healthier beverage choices (Dependent variable model)				
Intercept 0 healthier beverages 1 healthier beverage	−0.28	0.20	−1.44	0.15
Intercept 1 healthier beverage 2 healthier beverages	1.43	0.22	6.63	<0.001
Economic incentives: Present	0.18	0.22	0.79	0.43
Price awareness	−0.12	0.11	−1.10	0.28

	0 healthier beverages	1 healthier beverage	2 healthier beverages
ACME [95% CI]	−0.00 [−0.02 – 0.01]	0.00 [−0.00 – 0.01]	0.00 [−0.00 – 0.01]
ADE [95% CI]	−0.04 [−0.14 – 0.07]	0.01 [−0.02 – 0.05]	0.03 [−0.05 – 0.10]
Total effect [95% CI]	−0.04 [−0.15 – 0.06]	0.01 [−0.02 – 0.05]	0.03 [−0.05 – 0.10]

Note. ^a $p < .05$. Both models are adjusted for gender. The inclusion of pre-adolescents' relative healthy beverage consumption as an additional covariate produced similar results. Continuous independent variables were standardized. ACME = average causal mediation effect (indirect effect), ADE = average direct effect. Nonparametric bootstrap confidence intervals with the percentile method used for variance estimation (1000 simulations), used sample size = 280.

influence children's (8–10 years old) independent snack purchases when they were alone (Landwehr & Hartmann, 2024). Other studies on the impact of economic incentives on children's or adolescents' healthier choices reported mixed findings (Hartmann et al., 2017; Jensen et al., 2011; Landwehr et al., 2023; Salvy et al., 2012).

A potential explanation why economic incentives did not affect healthier beverage choices could be that preadolescents had low levels of price awareness and did not frequently purchase foods or beverages. This could be due to the relative young average age among pre-adolescents (10 years old). Preadolescents who were older purchased foods or beverages more often and had higher levels of price awareness, suggesting that price awareness may be more important among older preadolescents who frequently purchase foods or beverages (Jensen et al., 2012). Although children are able to understand prices and their expertise improves as they get older, it has been argued that children's price knowledge skills are far less developed compared to adults (Damay, Guichard, & Clauzel, 2014). This may be attributed to limited cognitive development which affects how children process prices. Preadolescents between 7 and 12 years old focus on functional attributes when evaluating prices (e.g., quality). From 13 years, adolescents are able to think abstractly and evaluate prices within a broader context (e.g., pricing reputation of the store) (Damay & Guichard, 2016).

No support was found for a mediating effect of price awareness in explaining healthier beverage choices. Similarly, another study found that price consciousness was not associated with snack buying intentions among children (Nørgaard, Sørensen, & Grunert, 2014). It has been argued that the purchasing context influences whether preadolescents consider prices. Preadolescents seem to pay more attention to prices if they buy products for themselves using their own pocket money (Damay & Guichard, 2016). An explanation why price awareness was not associated with economic incentives and healthier choices in the current study could be that preadolescents used simulated money to purchase beverages, instead of their own pocket money. This purchasing context may have reduced their sensitivity to price when making their choices. When adolescents actually have to use their own pocket money to pay for products, price awareness may exert a larger influence on purchasing decisions (Nørgaard et al., 2014).

Parental rules regarding beverage consumption did not interact with

preadolescents' descriptive norm towards healthier beverages. Similarly, a previous study found that restrictive parental guidance (e.g., setting restrictions and limits on food choices) was not associated with perceived norms towards fruit and vegetable consumption among children and adolescents aged between 10 and 16 (Yee, Lwin, & Lau, 2019). However, the present study found that preadolescents were less likely to choose healthier beverages when parents reported higher levels of rules regarding beverage consumption. Findings are in line with previous studies reporting that parental rules or expectations were related to increased consumption of snacks and/or SSBs during independent eating occasions (Reicks et al., 2023) or general dietary behaviors (Fleary & Ettienne, 2019; Loth, MacLehose, Larson, Berge, & Neumark-Sztainer, 2016; Monroe-Lord et al., 2022). Rules regarding beverage consumption may have counterproductive effects when preadolescents make independent beverage choices (Loth et al., 2016). An explanation for this finding could be the "forbidden fruit effect" which describes that anything that seems unavailable is more desirable (Binder, Naderer, & Matthes, 2020). For example, preadolescents who would normally not be allowed to drink SSBs might have seen the choice task (without parental oversight) as an opportunity to choose these beverages. Similarly, a qualitative study suggested that preadolescents may demonstrate their independence through resisting parental guidelines and opting for unhealthy choices (Mandal & Tripathi, 2022).

Other studies reported opposite or non-significant findings for the relationship between rules or expectations and independent snack choices (Wang & Fielding-Singh, 2018) or general dietary behaviors (Ezendam, Evans, Stigler, Brug, & Oenema, 2010; Gevers, van Assema, Sleddens, de Vries, & Kremers, 2015; McCormick et al., 2021; van de Gaar et al., 2017; Yee et al., 2017). A possible explanation for these inconsistent findings could be that previous studies defined different concepts and there is no clear differentiation between rules, limits and restrictions (Vaughn et al., 2016). In addition, the content and type of rules may influence food or beverage choices. It has been suggested that positively oriented food rules may be more effective in promoting healthier choices than restrictive food rules that target undesirable behaviors (e.g., drinking SSBs) (Daly, O'Sullivan, & Kearney, 2022; Yee et al., 2019). The present study mainly focused on restrictive rules targeted at drinking SSBs, which may explain the negative association with healthier beverage choices.

Strengths of the study include the experimental factorial design, the measurement of actual beverage choices and a large sample size with both preadolescent- and parent-reported measures. Several limitations need to be addressed. First, the majority of parents were highly educated, which may limit the generalizability of the findings. Second, preadolescents may have perceived the setting of the study (an activity during a day out at a museum) as a special occasion, which could have led to different choices than they might have otherwise made (Wang & Fielding-Singh, 2018). Third, purchasing two beverages at once may not reflect the most common purchasing scenario, which may limit the generalizability of the findings. Beverage pair choices in which preadolescents chose water alongside an unhealthier beverage were common (see Supplementary material), which may suggest a form of compensatory behavior for their unhealthy choice. Fourth, no actual money was used and familiarity and liking of beverages in the simulated shop were not measured. In addition, the weight status of preadolescents and parents was not assessed. Fifth, self-report questionnaires were used and a research assistant was present in the room when preadolescents were asked to purchase beverages, which may have led to social desirability bias.

Results of the study suggest that increasing the relative availability of healthier options (while keeping the total numbers of options constant) is a useful strategy to promote healthier beverage choices among preadolescents. The present study used beverages which contained less than 4 kcal/100 ml as healthier variants. There has been discussion about the appropriateness of replacing SSBs with low-calorie sweetened or artificially sweetened beverages (ASBs) (Chatelan, Raeisi-Dehkordi, &

Salehi-Abargouei, 2024). A recent review found that replacing intake of SSBs with non-caloric beverages was associated with a small reduction in BMI among children and adolescents (Tobiassen & Køster-Rasmussen, 2024). The authors concluded that ASBs appear better than caloric alternatives regarding the prevention of weight gain. Moreover, it has been argued that consuming ASBs may help to transition from SSBs to water (Malik & Hu, 2022). Based on results from the present study, preadolescents may be more likely to select healthier beverages (e.g., ASBs) if the assortment of healthier beverages is increased, without noticing differences in perceived healthiness. For example, schools could increase the relative availability of healthier items to facilitate healthier choices at school (Devine et al., 2023).

Future research could further investigate how increased availability affects healthier choices among preadolescents. For example, effects of different proportions of available healthier options versus less healthy options could be tested, as well as a wider range of food or beverage options. In addition, future studies could explore underlying mechanisms explaining the effect of altering availability on healthier choices among preadolescents, with or without the use of financial tax interventions, to better disentangle the specific effects. It would be interesting to examine whether the presence of peers influences the healthiness of preadolescents' choices by creating a salient descriptive norm and possibly stronger identification with the norm referent group. Furthermore, the role of preadolescents' preferences towards specific options could be explored as potential mediator explaining the effect of increased availability (Pechey, Hollands, & Marteau, 2022). Additional studies are needed to gain more insight in the impact of economic incentives on preadolescents' healthy choices. For example, future studies could investigate effects of economic incentives by using actual money among older preadolescents who have more food-related autonomy. The measurement of price awareness among preadolescents in the context of food or beverage choices could be improved to enhance internal consistency and provide a more comprehensive measure of the construct. In addition, future studies could differentiate between parental rules, limits and restriction to examine associations with healthiness of preadolescents' independent food or beverage choices.

In conclusion, results of this experimental study show that a relative large assortment of healthier beverages could promote healthier beverage choices among preadolescents. Increasing relative availability of healthier options could be a promising intervention strategy to support preadolescents in making healthier choices. Preadolescents seem less likely to choose healthier beverages when parents use higher levels of rules regarding beverage consumption. Findings of the study contribute to the understanding of how food environments can be altered to support healthier independent choices.

CRedit authorship contribution statement

Roselinde L. van Nee: Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Femke Mulder:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Ellen van Kleef:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Hans C.M. van Trijp:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Ethics statement

The study was performed in accordance with the Declaration of Helsinki, and the project proposal was approved by the Social Sciences Ethics Committee of Wageningen University & Research. Parents and preadolescents were asked to provide consent.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2024.107714>.

Data availability

The data for the current study will be made available on <https://zenodo.org/> by the authors.

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