IZVORNI ZNANSTVENI RAD / ORIGINAL SCIENTIFIC PAPER

Consumption patterns of beverages and their contribution to total energy intake in toddlers

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Abstract

In children a number of dietary habits have been associated with overweight or obesity, and sugar-sweetened beverages consumption seems to be one of them for a while. The majority of studies with strong methodology have indicated a positive association between sugar-sweetened beverages consumption and risk of obesity. The aim of the study was to identify beverages intake and their share in daily energy intake in toddlers, with special focus on the sugar-sweetened beverages. Data from three non-consecutive dietary records were used to assess average beverages intake pattern among 96 toddlers (12 – 36 months old, 46 females and 50 males). Dietary records were recorded by mothers as a surrogate respondents. Milk was most consumed beverage in toddler's diet (24 % volume of total beverages intake). Also, milk was the leading source of calories from beverages. The second and the third most consumed beverage groups were water (19 % volume of total beverages intake) and carbonated soft drinks & fruit-drinks (14 % volume of total beverages intake), while fruit juice (100%) was the least consumed beverage (10% volume of total beverages intake). The proportion of total energy intake from sugar sweetened beverages was 5 %. Based on identified beverage intake pattern in the study sample of Croatian toddlers, it can be concluded that substantial amount of energy is coming from SSB, but also that the water intake should be encouraged because total water intake was inadequate in 23% of participants.

Keywords: *obesity, toddlers, sugar-sweetened beverages, energy intake, water*

Introduction

Sugar-sweetened beverages such as soft drinks and fruit drinks are the primary source of added sugar in a child's daily diet (Guthrie and Morton, 2000). The increase in prevalence of obesity coincides with a large increase in consumption of sugar-sweetened beverage in children (Duffey and Popkin, 2007). It has been estimated that percent of total daily calories from sugar-sweetened beverages increased from 3.9% in the late 1970's to 9.2% in 2001 (Duffey and Popkin, 2007). Among children aged 2-19 years, SSB intake increased from 4.8% to 10.3% of total energy intake. Similar trends of increase consumption has also been observed across Germany, Australia, Spain and Great Britain (Ismail et al., 1997).

In 2012., as a part of routine monitoring of nutritional status and dietary habits among schoolchildren in Republic of Croatia, 32.6% of participants were overweight and 13.2% were obese (Croatian Health Service Yearbook, 2013), while representative data about overweight and obesity prevalence in Croatian preschool children and toddlers are missing. Beverages are important part of toddlers' diet, but depending on the choice of beverage they could also significantly contribute to the intake of "empty calories". Consumption of sugar-sweetened beverages (SSB) has consistently been associated with increased energy intake and is thought to play a role in the aetiology of obesity. SSB include the full spectrum of soft drinks, carbonated soft drinks, fruit drinks, sports drinks, energy and vitamin water drinks and sweetened iced tea, which collectively are the largest contributor to added sugar intake in the world (DiMeglio and Mattes, 2000). Lately, the number of studies about the excessive intake of sweetened beverages in children and adolescents is increasing (Han and Powel, 2013). Recent review showed that the majority of studies with strong methodology had indicated a positive association between SSB consumption and risk of obesity, especially among overweight children (Bucher Della Torre et al., 2016). Poor nutrition and displacement of consumption of milk and dairy products, which include high consumption of SSB, during the first few years can have short- and long-term adverse effects on physical and mental development, as well as increasing the risk of chronic adult disease (More, 2012). SSB are thought to be more fattening than sugars in solid form because they don't satiate (Mattes, 2006).

Few studies about the intake of sweetened beverages in toddlers has been published (Warner et al., 2006; Garnett et al., 2012; Hafekost et al., 2011), however there is no information about SSB consumption in Croatian toddlers.

The aim of the study was to identify beverages intake and their share in daily energy intake in toddlers, with special focus on the SSB. Moreover, total daily water intake was estimated in toddlers, as most appropriate choice of beverage.

Subjects and methods

Subjects

The study was conducted in Zagreb between July 2013 and December 2014. The invitation to join the study has been sent to the colleagues, friends or acquaintances of the researchers on this project. A total of 96 generally healthy toddlers (12-36 months) were included in the study. All the parents or caregivers voluntary agreed to participate in this research and have signed informed consent. The protocol was approved by the institutional ethics committee of the Children's Hospital Zagreb.

Dietary assessment methods

Three dietary records were collected (two working days and one day during weekend) for assessing beverages intake pattern. Together with dietary record every mother have received detailed instruction about how to measure different foods, how to write recipe for complex dishes, example of filled one-day dietary record, templates for measuring the food dimensions and picture with size of food utensils. Besides dietary records, each surrogate respondent has completed the general questionnaire with data such as anthropometric parameters measured at last visit to paediatrician and water consumption habits. Using WHO Anthro Application (WHO, 2011) based on body mass index percentiles were determined.

Total energy intake, energy intake of sugar-sweetened beverages and water intake from beverages and food have been the focus of dietary record analyses. The national food composition tables have been used for analyses (Kaić-Rak and Antonić, 1990), Danish Food Composition Databank (Moller et al., 2005) was used for certain food that have not been available in national tables, and for specific beverages food labels were used. Intake of each beverage is calculated as the average intake of drink that was recorded during three days.

Beverage Classification

For the purpose of this analysis, beverages were classified into 5 main groups: water, tea (no added sugar), non-flavoured milk, fruit juice (100%) and sugar-sweetened beverages (SSB). Sugar-sweetened beverages were further categorised into carbonated soft drink & fruit-drink (including iced-tea and fruit nectars), tea (with added sugar) and flavoured milk (cocoa powder with milk or chocolate milk. Although tea with added sugar was not considered as sweet drink (Hafekost et al., 2011), we have observed a large intake of the same so it was included in sugar-sweetened beverages group.

Statistical analyses

All analyses were performed with SPSS (version 15, Chicago, IL, USA) and p values < 0.05 were considered significant. Standard descriptive statistics were conducted for presenting beverage intake pattern. Independent samples T-test (or Mann-Whitney U test for non-parametric data) was used for examining the difference in the beverage intake of toddlers according to age.

Results and discussion

Participants Characteristic

The participant characteristics were presented in Table 1. This study has included 50 participants (52.1%) aged 12-24 months and 46 participants (47.9%) aged 24-36 months. In the study of Hafekost et al. (2011), 24.6% of children aged 24-36 months, but this study has included larger sample of participants (1191 participants). Body Mass Index (BMI) in our study was determined in percentiles. Because there are no Croatian growth charts for children aged 12 – 36 months, WHO Anthro Application (WHO, 2011) was used. Approximately 5% of children have been under-weight, 12.5% have been overweight and 8.3 % have been obese. In the study of Hafekost et al. (2011) 4 487 children aged between 2 and 16 years has participated, but because the older children were included comparison was not possible.

Table1. *Participant characteristics*

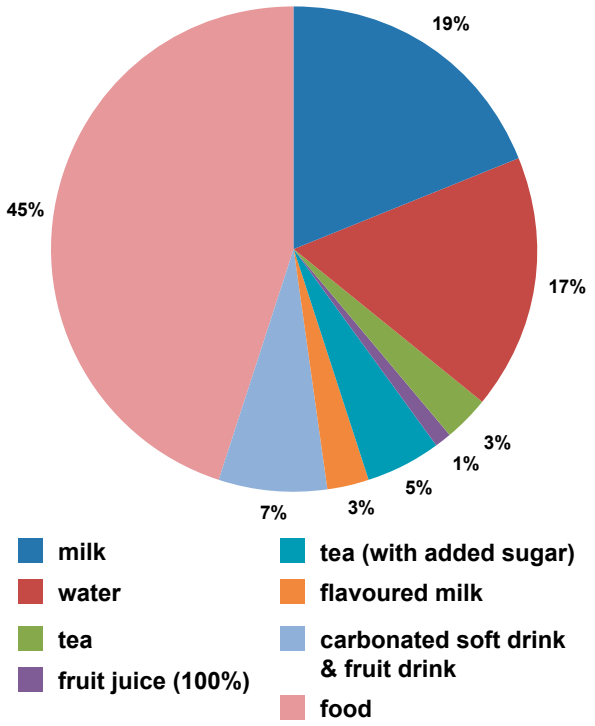
Subjects	N (%)	Birth weight (g)	BMI for age (percentiles)	Age (month)
Girls	46 (47.9 %)	3 420	55.5	24.1
Boys	50 (52.1 %)	3 575	49.4	23.6
Total	96 (100 %)	3 497	52.5	23.9

Dietary records were recorded by mothers as a surrogate respondents. Under usual research circumstances, the surrogate would optimally be the parent who had primary responsibility for food preparation (Samet and Alberg, 1998). Feeding the family i.e. planning meals, food shopping, preparing meals and serving meals has traditionally been responsibility of women in Croatia. In the recent systematic review of the validity of dietary assessment methods in children mothers reported dietary intake in 13 studies while fathers were surrogate respondents only in two of 15 studies (Burrows et al., 2010). The study of Eck et al. (1989) didn't show an appreciable difference between the accuracy of surrogate information comparing mothers and fathers, while recent study in children aged 8-11 years have found fathers more accurate than mothers in reporting child's food intake (Burrows et al., 2013). This means fathers could be used more actively within studies that measure child dietary intake in the future (Burrows et al., 2013).

Water intakes from plain water, beverages, and foods

Plain water and other beverages contributed 55% of daily water intakes while moisture in foods provided 45% of total water intake among Croatian toddlers (Figure 1).

Figure 1. *Contribution to total water intake from plain water, other beverages and from moisture in foods*



In the study of Drewnowski et al. (2013), daily water intake from plain water and other beverages contributed 71.4 % while from food have contributed 28.6 %. Although in mentioned research percentage of daily water intake from plain water and other beverages has been higher, and the water content in the food has been less, that could be explained by larger sample size and higher age of participants. It is calculated that of the total water consume about 20-30% typically comes from food and 70-80% from beverages (EFSA, 2010). According to Figure 1, from SSB, the largest contribution of water content has come from the category of carbonated soft drinks & fruit drinks. Non-alcoholic soft drinks & fruit drinks accounted for 7% of total water intake.

For the age 12-36 months, a total water intake of 1100-1300 mL/day is considered adequate (EFSA, 2010). Almost quarter of participants (23%) haven't met EFSA recommendations for total water intake. Total water intake obtained in the present study is similar to total water intake found by Drewnowski et al. (2013), however since water intake recommendation for older children is higher their study has shown a larger deviation from the recommendations.

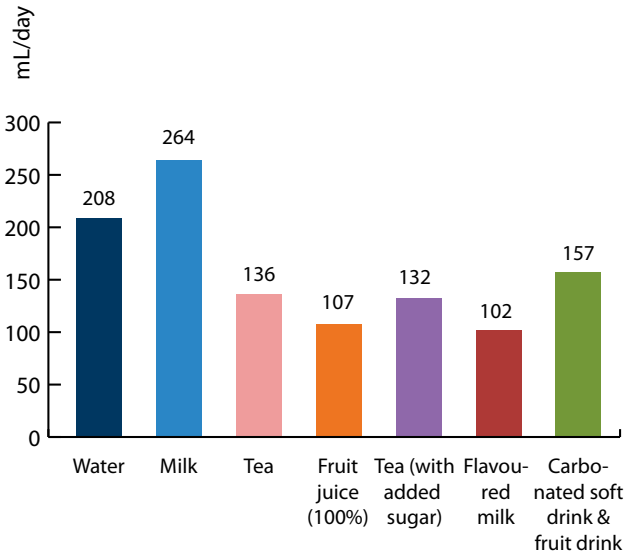
When water intake was expressed in relation to energy intake, average intake was 0.83±0.2 mL/kcal, lower than recommended 1.2 mL/kcal (D-A-CH, 2008).

Assessment of beverage intake in toddlers and their contribution to total energy

Analysis of data showed that milk was mostly consumed beverage in toddler's diet (82 participants) (Figure 2). Also, the milk was beverage with the biggest daily volume consumed while fruit juice (100%) was the least daily consumed beverage. Flavoured milk was the lowest daily volume consumed sugar sweetened beverage. On the other hand, these values are higher than those reported for Australian children whose daily volume intake of flavoured milk is 38.8 mL (Hafekost et al., 2011).

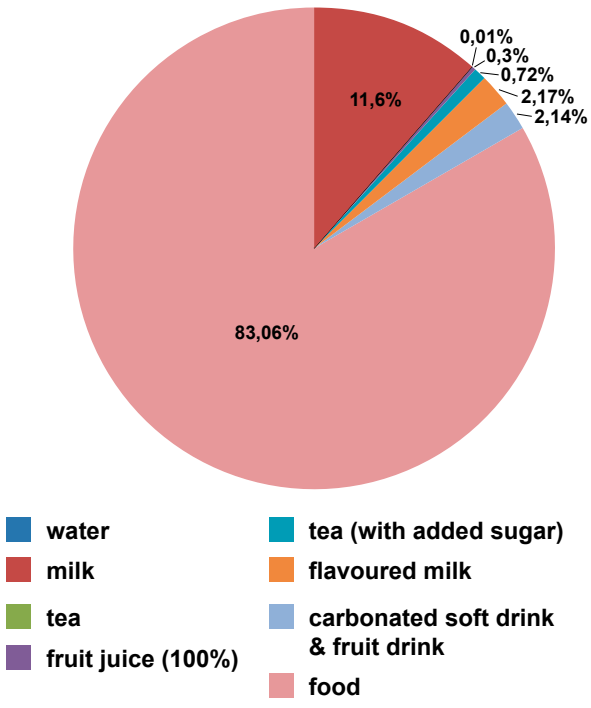
Average value of total daily beverages intake in Croatian toddlers was 628.3±234.6 mL.

Figure 2. *Daily beverages intake in toddlers based on the intake of consumers*



Tea with added sugar accounted for 1% of total energy intake, while flavoured milk accounted for 2% of total energy intake as similar as carbonated soft drink & fruit-drink (Figure 3).

Figure 3. *Proportion in total daily energy intake from food and beverages*



Since the category of sugar-sweetened beverages of this study has been different from previous studies, it has not been possible to compare the results of SSB subcategories. Recent review article emphasized the need for consensus on the definition of SSB (Bucher Della Torre et al., 2016). The proportion of total energy intake from sugar-sweetened beverages was 5% of average daily energy intake (Table 2).

Table 2. *Contribution of SSB to total daily energy intake according to level of consumption*

Level of SSB Consumption	% Total Daily Energy Intake	-95% CI	+95% CI	Med	Min	Max	SD
Low-Moderate*	3.33	2.68	3.99	3.00	0.00	9.00	2.10
High**	9.27	7.31	11.24	9.00	2.00	23.20	5.55
Total	5.03	3.99	6.07	4.10	0.00	23.20	5.02

* <1/3 of average daily beverage intake from SSB
** >1/3 of average daily beverage intake from SSB

The results corresponds to Australian children aged 4-8 years while Austalian children (aged 24-36 months), daily consumed 4% of total energy through sugar-sweetened beverages (Hafekost et al., 2011). The present results are lower than those reported for US children (2-18 years) whose SSB intake is approximately 10 % of their energy intake (Nielsen and Popkin, 2004). However, given the growing evidence that suggests biological mechanisms linking high and regular consumption of SSB with negative short and long term health outcomes effective public health intervention to reduce levels of intake are recommended (Vartanian et al., 2007).

Overall, 44% of mothers have reported that their toddler have drank SSB every day of survey. Garnett and colleagues reported that 8.7% of 24 months old have consumed SSB through 3 days of survey (Garnett at el., 2012). In our study 21.9 % mothers have reported that their child have not consumed SSB during days when dietary record have been registered.

Children were classified as high, low-moderate or non-consumer of SSB based on their level of intake SSB during the study period. Children whose SSB intake contributed more than one third to their total daily intake of beverages were classified as high consumers. Those who reported no SSB consumption during the study were labelled non-consumers, and the remaining were considered low-moderate consumers (Hafekost et al., 2011). Approximately, 22% reported no consumption SSB during the study period, 44% reported low-moderate consumers and 34% reported as high consumers.

The results corresponds to Australian results. Approximately, 66% of Australian children were considered low-moderate consumers (Hafekost et al., 2011).

Assessment of SSB intake with according to age

There was statistically significant difference in sugar-sweetened beverages intake between younger (12-24 months) and older (24-36 months) toddlers ($p < 0.001$) (Table 3). The same Hafekost and colleagues reported in Australian children (Hafekost et al., 2011).

Table 3. *Difference in sugar-sweetened beverages intake according to age*

Beverage	Age (12 - ≤ 24 months)			Age (> 24 – 36 months)			P
	mL	-95% CI	+95% CI	mL	-95% CI	+95% CI	
Sugar sweetened beverages	130.42	88.02	172.82	231.48	177.07	285.89	0.001*

* p< 0/05

The main strength of this study was providing missing data about beverages intake and their share in daily energy intake in Croatian toddlers, with special focus on the SSB. Despite that fact, there are also several limitation of study. Results are presented in relative small study sample which could not be representative also with respect to socio-economic status. The consumption of SSB was based on mothers' report of food consumed on the days mainly spent at home. According to European Food Safety Authority guidelines for food consumption data collection, two non-consecutive food diaries are recommended as dietary assessment method for children (EFSA, 2014). Although methodology used in this study complies with the recommendations the study sample should be enlarged. Identified beverages intake pattern should be used to create and validate open ended food frequency questionnaire that could be used for assessing SSB intake in larger study sample.

Conclusion

Inadequate water consumption relative to the EFSA AI values was found in 23% of toddlers. Not surprisingly, milk was the leading source of calories from beverages considering its caloric value and the biggest daily volume consumed. SSB contributed with 5% to total daily energy intake. There was statistically significant difference in sugar-sweetened beverages

intake between younger and older toddlers. Sugar-sweetened beverages contributed a substantial amount of energy to the diet of participants in our preliminary study. Identification of beverage intake pattern in toddlers highlighted the need for future research, policy recommendations and interventions targeting parents of young children.

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