

Water and Beverage Consumption among Children and Adolescents in Tehran Metropolitan City of Iran

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Abstract—Introduction: Adequate hydration is necessary for proper physical and mental function. The aim of this study is to determine the consumption of water and all other beverages in children (8-13 years) and adolescents (14-17 years) in Tehran metropolitan city of Iran. Materials and Methods: In this cross-sectional study, 455 children (8-13 years) and 334 adolescents (14-17 years) were retrieved from north, center, and south of Tehran (18 schools). Instrument for data collection consisted of a “demographic and general health” questionnaire and a “7-day fluid record”. Data analyses were performed with SPSS 16 software. Results: The mean total consumption of fluids in school children was 1302 ± 500.6 ml/day. The highest mean intakes were observed for water (666 ± 398 ml/day), followed by milk (239 ± 183 ml/day), regular soft beverages (RSB) (188 ± 148 ml/day), and juices (60 ± 74 ml/day). Water, hot drinks (mainly tea) and soft drinks intake was significantly more in boys than girls. A significantly lower intake of milk and a higher intake of RSB and hot beverages (mainly tea) have been seen among adolescents compared to children. Conclusion: The most important finding is that mean fluid intake of children and adolescents does not meet international adequate intake references for water and fluids. This finding may suggest the necessity of development of the local references. To improve fluid intake habits of children and adolescents, relevant policy making and actions are warranted.

Keywords—Adolescents, beverages, children, water.

I. INTRODUCTION

WATER is one of the basic needs of life, so that lack of it can lead to death [1]. This is especially important in childhood to adolescence in which there is a need for relatively large quantities of water to maintain proper body composition [2]. In case of severe lack of water and decreased sympathetic nervous activity, impairment in the system of thermo genesis and physical and behavioral effects of the individual are observed [3], [4]. On the other hand, in recent years, World Health Organization has warned about increasing consumption of sweetened beverages [5]. In children who consume more of these drinks, overweight and obesity have been observed [6]. In addition, the increase in the consumption of these beverages is associated with the prevalence of tooth decay in children and adolescence [7].

According to the consequences of using these beverages reconsidering their consumption in children and adolescents is essential. Despite the importance of receiving water and fluids in children and adolescents, limited studies in this area are available not in Iran, and in the world. Limited available data also indicate that children and adolescents do not consume

fluid in proper dosage [8]. Total consumed fluid is the sum of water and drinks consumed by the individual and it is assumed that it consists 80% of all fluids consumed by a person (20% are provided from the food) [9]. The purpose of this study is to determine the consumption of different types of fluids (water and beverages) in children and adolescents aged 8 to 17 years old in Tehran metropolitan city of Iran.

II. MATERIAL AND METHODS

Tehran was divided into three geographical regions of north, center, and south. In each region, from each level of primary, secondary and high schools one males' school and one females' school were randomly selected (18 schools). Data were collected by two questionnaires. A questionnaire for general information and lifestyle of students contained questions about age, sex, weight, height, record of various diseases, consumption of milk and soft beverages, fruits and vegetables, and physical activity. For the determination of consumed beverages, a self-administered fluid record was used. In this note, information about the day, hour, number of times, type, amount, location and motivation of drinking fluids was recorded for seven days. On the margin of this note, 15 codes were attached for each type of beverage. One appendix also included images and codes associated with the types of bottles, glasses and dishes normally used to drink beverages in Iran to help determine the volume of fluid used. Students' weight and height were measured by standard method in schools. Body Mass Index (BMI) was determined.

BMI-Z-scores for age and sex were calculated based on World Health Organization Child Growth Standards [10], [11]. Children and adolescent weight status were reported in four categories as: underweight (z score: $< -2SD$), normal (z score: $\geq -2SD$ and $\leq 1SD$), overweight (z score: $> 1SD$ and $\leq 2SD$) and obese (z score: $> 2SD$).

The database was designed to enter data in the ACCESS MS. After editing and deleting the data, the necessary analyzes were done by SPSS 19 software. Quantitative data were presented as mean \pm standard deviation, and qualitative data were presented as frequency. T-test for independent groups or variance analysis was used to compare the quantitative data in different subgroups.

III. RESULTS

Data related to 944 students were collected. After controlling and excluding the incomplete questionnaires, the final analysis was done on 789 fluid records. The sexual distribution of the participants and the age distribution in sexual subgroups are approximately the same (Table I).

TABLE I
SEX AND AGE GROUP DISTRIBUTION OF CHILDREN AND ADOLESCENT IN TEHRAN

Sex	N	%	Age	N	%
Boys	368	%47	8-13	220	%28
			14-17	148	%19
Girls	421	%53	8-13	235	%30
			14-17	186	%23
Total	789	%100	8-13	455	%58
			14-17	334	%42

The mean total fluid intake in the studied students was 1302.5 ± 500.6 ml (296 ml to 4031 ml), and the frequency intake was 7.6 ± 2.3 times per day (up 3 to 14 times) (Table II).

Boys consumed fluids about 180 ml more than girls, which was statistically significant, but there was no significant difference between two age groups. As it is expected, by

increasing weight and BMI, the amount of fluid intake also increases (Table III). However, the amounts of consumption in different urban areas that in terms of social and economical conditions are at different levels is not significant. The mean consumption of fluids in girls and boys 8-13 years old was respectively equal to 1227 and 1350 ml a day. This amount is without calculating the water in the food. The Adequate Intake (AI) recommended by the American Institute of Medicine (IOM), which also contains water in foods, is about 2,100 and 2,400 ml per day for boys and girls of this age group, respectively (European Food Safety Authority). EFSA (European Food Safety Authority) recommends less than this amount. The organization recommends 1900 ml of fluids per day for girls 9 to 13 years old and for the boys in this age group 2100 ml.

TABLE II
MEAN TOTAL FLUID INTAKE BY GENDER IN CHILDREN AND ADOLESCENT IN TEHRAN

Sex	N	Mean	SD	SE	95% Confidence Interval		Min	Max
					Lower	Upper		
Boys	368	1400.7	511.2	26.6	1348.3	1453.1	375.6	3607.4
Girls	421	1217.0	475.6	23.2	1171.4	1262.6	298.9	4030.8
Total	789	1302.7	500.6	17.8	1267.7	1337.7	289.9	4030.8

TABLE III
MEAN TOTAL FLUID INTAKE (ML / DAY) IN DIFFERENT WEIGHT GROUPS IN CHILDREN AND ADOLESCENT IN TEHRAN

Categorizes weight by BMI	N	Mean	SD	SE	95% Confidence Interval		Min	Max
					Lower	Upper		
Under weight	17	1082.1 ^a	409.2	99.2	871.7	1292.5	532.1	1935.3
Normal	451	1241.5 ^c	460.6	21.7	1198.9	1284.2	298.9	3607.4
Overweight	186	1386.4 ^d	513.3	37.6	1312.2	1460.7	433.9	4030.8
Obese	116	1430.4 ^b	594.1	55.2	1321.1	1539.7	375.6	3328.4
Total	770	1301.5	501.2	18.1	1266.0	1336.9	298.9	4030.8

a, b: P = 0.05, c, b: P = 0.002, c, d: P = 0.007.

TABLE IV
MEAN FLUID INTAKE (ML / DAY) BY SEX IN CHILDREN AND ADOLESCENT IN TEHRAN

Fluids	Boys	Girls	P-value
	N=368	N=421	
	Mean \pm SD	Mean \pm SD	
Water	707.5 \pm 414.8	630.5 \pm 380.5	0.01
Hot drinks (tea, coffee)	202.0 \pm 143.9	176.6 \pm 150.0	0.02
Milk-based drinks	247.7 \pm 181.2	231.6 \pm 185.0	0.22
Fruit Juices (natural, artificial)	62.5 \pm 78.7	57.1 \pm 69.8	0.31
Carbonated soft drinks	134.9 \pm 129.6	81.8 \pm 82.0	0.001
Syrups/distillates	23.3 \pm 51.2	21.0 \pm 42.8	0.48
Energy drinks	10.8 \pm 37.1	6.4 \pm 30.3	0.06
Others	6.6 \pm 21.8	8.4 \pm 29.2	0.33

The consumption of fluids, water, hot beverages (mainly tea) and carbonated soft drinks intake in boys is significantly higher than that of girls (Table IV).

IV. DISCUSSION

This research is the first study in Iran to investigate the use of beverages in children with a 7-day fluids recording method. The mean consumption of fluids in all samples was 1302 ml.

Existing limited data show that children and adolescents do

not drink fluids in reference levels in different parts of the world. The total amount of fluids intake is the sum of water and drinks, which is assumed to account for 80% of the total intake of water (20% is provided from the food) [9]. Including the provision of 20% of the needed water from the food, about 85% of girls and 95% of boys aged 8 to 13 years consumed fluids less than IOM reference. Fluids recommendation for boys and girls 9- 13 years is 2.4 L/day and 2.1 L/day, respectively [12].

But European EFSA recommends lower levels as adequate intake for children and adolescents. These recommendations for boys and girls aged 9-13 are 2.1 L and 1.9 L, respectively [9]. In this way, compared to EFSA recommendations, 75 percent of girls and 85 percent of boys aged 8 to 13 years old consumed less fluids than reference levels (taking into account 20 percent water from food). In the United States, despite the increased intake of fluids in the age group of 9-13 years (1711 ml / day), 73% of girls and 75% of boys received less water and fluids than recommended EFSA reference [13]. In this way, 80% of adolescent girls and 95% of boys in Tehran are not able to receive fluids in the mentioned amounts. In France, the average consumption of fluids in the two groups of 6-11

and 12-19 years old was 1046 and 1111 ml/day, respectively [14], which is lower than that of Iranian children. One of the findings of the study was that boys use fluids more than girls. The results of studies conducted in other countries also show similar results, but there is a higher chance of receiving EFSA levels for girls [8].

The largest proportion of fluid intake was related to water, accounting for 51% of all intake of fluids. In Spain, France, Belgium, and Turkey, water accounts for 42-53% of the total consumption of fluids in children and adolescents [15]. In French children aged 6 to 11 years, water intake was approximately the same as Iranian children (549 ml), which accounted for 52% of the daily intake of fluids [14]. In American children, water accounted for about 33% of the taken fluids in adolescents aged 12-19 years [16] and in Brazilian children accounted for about 30% of the fluids, which was constant from 3 to 17 years old [17]. Despite the consumption of more fluids by English children, their drinking water was about 600 ml, or about 38 percent of the total intake of fluids [18]. In the study of HELENA, the highest proportion of taken beverages in European adolescents 12.5 -17.5 years old was related to water (821 ml) [19].

As noted, the proportion of different drinks varies among children and adolescents. In children after water, milk and juices were the most consumed drinks, while the consumption of hot beverages and carbonated soft drinks was most after water in adolescents. In Brazil, Uruguay, Argentina, France and China, consumption of hot drinks in adolescents has been reported more than in children [15]. In addition to Iran in Brazil, Uruguay, Spain and Turkey, consumption of carbonated soft drinks in adolescents is more than in children [15].

The consumption of sweet drinks (carbonated soft drinks, artificial fruit juices, syrups, sports drinks and energy drink) in Tehran's boys was 208.5 and in girls 174.81 ml/day. Here, the share of carbonated soft drinks is higher than other drinks, so that in boys 64% and in girls, 47% of sweet drinks come from this group. As a result, boys use an average of 4,000 ml per month, equivalent to 4 bottles of one liter, and girls of 2466 ml, which is about 2.5 bottles of 1 liter carbonated soft drinks. In Mexico, which has one of the highest per capita consumption of high-energy drinks, the per capita consumption of carbonated soft drinks in adolescents aged 12-18 years is about 201 ml per day, which is about 6 bottles of 1 liter per month [20]. Studying the trend of drinking beverages in this country shows that between 1999 and 2006, the consumption of high-energy drinks (carbonated soft drinks, juices containing sugar and sweet coffee) doubled in the age group of 12 to 18 years [20].

In the study of HELENA (8 European countries), the average consumption of sweet drinks (carbonated soft drinks, fruit juices and energy drinks) was higher than that of Iranian children, so that in boys it was reported 303 and in girls 160 ml per day. The study of fluid consumption in the United Kingdom shows that, among all age groups, the highest amount of carbonated soft drinks (430-640 ml/day) belonged to children and adolescents, especially the age group of 15 to

17 years old [18].

These findings emphasize the need to determine the pattern of consumption of beverages in childhood and adolescence and its correction. In the present study, 80% of adolescents said that they were the main decision-maker in determining the type of drink they consume. On the other hand, the highest percentage of beverages was consumed at home. These findings suggest that educational programs to modify the pattern of consumption of beverages should focus on teenagers and families simultaneously.

V. CONCLUSION

The findings of this study show that a large percentage of Iranian children use less water than the European and American reference levels (via liquids). In many countries, including European countries, there are similar findings, especially in adolescents. Considering that all studies have been carried out on healthy children, there is a suspicion that the reference values may be estimated more than the actual needs of Iranian children. The presence of many environmental factors (food patterns, weather, geographic region,..) can affect the amount of water needed, so it seems necessary to determine local reference values.

REFERENCES

- [1] Popkin BM, D'Anci KE, Rosenberg IH. Water, hydration, and health. *Nutrition Reviews*. 2010;68(8):439-58.
- [2] Stein AD, Shea S, Basch CE, Contento IR, Zybert P. Assessing changes in nutrient intakes of preschool children: comparison of 24-hour dietary recall and food frequency methods. *Epidemiology*. 1994;109-15.
- [3] Edmonds CJ, Burford D. Should children drink more water?: The effects of drinking water on cognition in children. *Appetite*. 2009;52(3):776-9.
- [4] Edmonds CJ, Jeffes B. Does having a drink help you think? 6-7-Year-old children show improvements in cognitive performance from baseline to test after having a drink of water. *Appetite*. 2009;53(3):469-72.
- [5] Guideline: WHO. sugar intake for adults and children , Geneva. (2015).
- [6] Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. 2013;346:e7492.
- [7] Moynihan P, Kelly S. Effect on caries of restricting sugars intake systematic review to inform WHO guidelines. *Journal of Dental Research*. 2014;93(1):8-18.
- [8] Iglesia I, Guelinckx I, De Miguel- Etayo PM, Gonzalez-Gil EM, Salas-Salvado J, Kavouras SA, et al. Total fluid intake of children and adolescents: cross- sectional surveys in 13 countries worldwide. *European journal of nutrition*. 2015; 54 (2):57-67.
- [9] Agostoni C, Bresson J, Fairweather-Tait S. Scientific opinion on dietary reference values for water. *EFSA J*. 2010;8(3).
- [10] http://www.who.int/growthref/who2007_bmi_for_age/en/ Accessed October 14, 2017.
- [11] De Onis M OA, Borghi E, Siyam A, Nishida C, et al. . Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization* (2007);85: 660-7.
- [12] Lennon M, Whelton H, O'Mullane D, Ekstrand J. Rolling Revision of the WHO Guidelines for Drinking-Water Quality. *World Health*. 2004.
- [13] Drewnowski A, Rehm CD, Constant F. Water and beverage consumption among children age 4-13y in the United States: analyses of 2005-2010 NHANES data. *Nutr J*. 2013;12(1):85.
- [14] Bellisle F, Thornton S, Hébel P, Denizeau M, Tahiri M. A study of fluid intake from beverages in a sample of healthy French children, adolescents and adults. *European journal of clinical nutrition*. 2010;64(4):350-5.
- [15] Guelinckx I, Iglesia I, Bottin J, De Miguel-Etayo P, Gonzalez-Gil E, Salas-Salvado J, et al. Intake of water and beverages of children and adolescents in 13 countries. *European journal of nutrition*. 2015;54(2):69-79.

- [16] Kant AK, Graubard BI. Contributors of water intake in US children and adolescents: associations with dietary and meal characteristics— National Health and Nutrition Examination Survey 2005–2006. *The American journal of clinical nutrition*. 2010;92(4):887-96.
- [17] Feferbaum R, de Abreu LC, Leone C. Fluid intake patterns: an epidemiological study among children and adolescents in Brazil. *BMC Public Health*. 2012;12(1):1.
- [18] Gandy J. First Findings of the United Kingdom Fluid Intake Study. *Nutr Today*. 2012;47:S14-S6.
- [19] Duffey KJ, Huybrechts I, Mouratidou T, Libuda L, Kersting M, De Vriendt T, et al. Beverage consumption among European adolescents in the HELENA study. *Eur J Clin Nutr*. 2012;66(2):244-52.
- [20] Barquera S, Hernandez-Barrera L, Tolentino ML, Espinosa J, Ng SW, Rivera JA, et al. Energy intake from beverages is increasing among Mexican adolescents and adults. *The Journal of nutrition*. 2008;138(12):2454-61.