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Consumption of Beverage among Secondary and Intermediate Students in Riyadh Schools, Saudi Arabia: A Cross-Sectional Study

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Abstract

Background: Water is essential for body hydration to maintain human mental and physical function. However, hot and humid weather, in addition to physical activity, can further increase fluid loss. We aimed to evaluate beverage consumption among school children aged 12-18 years in Riyadh, Saudi Arabia.

Methods: A cross-sectional study was conducted using an online self-administered questionnaire among intermediate and secondary school students. A random stratification technique was used to recruit schools followed by a non-random sampling technique of children's parents to recruit the adolescents 12-18 years. Descriptive statistics were used to summarize the participants' characteristics and beverage consumption.

Results: A total of 1548 children have completed the questionnaire with a mean age of (15.69±1.68) years. The majority (65.2%) were females. The daily mean total beverage consumption was (1918.88±796.01) ml/day for females and (2238.53±879.96) ml/day for males (p=<0.001). For children aged (14-18) years, beverage consumption was (2052.41±842.01) ml/day, and (1881.33±811.38) ml/day for children aged (12-13) years (p=0.007). The highest consumed beverage for females and males was water (1124.94±548.36) ml/day and (1209.59±534.31) ml/day, respectively (p=0.004). Children aged (14-18) years consumed higher coffee (206.84±234.29) ml/day compared to those aged (12-13) years (78.68±140.71) ml/day (p<0.001). Girls were drinking coffee (208.71±236.60) ml/day more than boys (158.36±206.54) ml/day (p<0.001).

Conclusion: Water was the most significant contributor to fluid consumption in all age groups; however, daily beverage consumption was lower than the World Health Organization recommendation. The largest proportion of adolescents is at risk of inadequate hydration.

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1. Introduction

Water is essential for life [1][2]. Without water, we cannot survive. As the water content in our bodies frequently fluctuates, it needs to be continuously replenished, and the best liquid for this purpose is water itself because it hydrates our bodies without providing extra energy (calories/kilojoules) [3]. Body hydration is essential for adequate mental and physical function. Slight dehydration may result in damaging outcomes both physically and intellectually, and excessive dehydration may accentuate serious potential ailments and can ultimately lead to death [4]. Fluid requirements vary between each individual according to many determinants, including age, weight, phase of perspiration, and nutritional lifestyle [4][5]. The percentage of fluids in the human body ranges from 55% to 75%, and water is required for the correct functioning of every single part of the human body. Water aids the kidneys in removing waste from circulation and excreting it outside the body as urine [6].

Dehydration occurs when the intake of water and fluids is less than the amount that leaves the body. When water loss exceeds 5%, this is considered to be a severe case of dehydration [7]. Also, dehydration has significant therapeutic impacts on several body systems [8], especially the kidneys. It has been recognized for quite a long period that drinking water helps avoid the formation of kidney stones. Extensive observational studies have suggested a therapeutic role in Chronic Kidney Disease prevention [9]. A fluid loss of 1% can lead to problems in physical activity, thermoregulation, and appetite. At 4% fluid loss, severe issues are noticed, such as inattentiveness, headaches, irritability, lassitude, an increase in body temperature, and labored breathing. A fluid loss of 8% or more results in death [10]. In the United States of America, a National Health and Nutrition Examination Survey was conducted; a 54% prevalence of dehydration was reported among individuals between the ages of 6 and 19 [11].

With the weather variations due to global warming, it is thought that unpredictable weather events will take place. It is projected that the situation in Asia will be dreadful in the 21st century as temperatures are projected to increase to unacceptable levels [12]. Temperature changes have already been detected using climate indices[13][14][15]. In the city of Riyadh, especially in the summer, the temperature reaches 40-45 degrees Celsius (°C) [16]. Humid and hot weather, along with physical exertion, can increase fluid loss; as a result, our bodies demand more fluid intake [17].

To deal with temperature fluctuations, the body's cooling system releases a large amount of fluid. Perspiration helps cool down the body temperature in warm weather and during physical activity. Its level depends on the ambient temperature, humidity, type of effort, and outfit [18]. Therefore, the daily fluid requirements on hot days (40°C) could be triple that on colder days (20°C) to compensate for water loss [19].

Euhydration is a significant factor in the prevention of accidents at work or the progress of the disease. This is because it improves performance in both mental and physical tasks and improves the perception of well-being. No matter how smooth, dehydration is not a tempting situation; it denotes that there is an imbalance within the homeostatic exertion of the internal background. This might aggressively impact the rational volume and interfere with the acceptable implementation of work or learning-related movements that necessitate the application of precise rational abilities [7]. According to the World Health Organization (WHO) Guidelines for Drinking Water Quality, the adequate intake of water for adolescents (9-13 years old) is 2,400 mL/day for boys and 2,100 mL/day for girls, and the intake for (14-18 years old) is 3,300 mL/day for boys and 2,300 mL/day for girls [20].

Dry tongue and lips, thirst, dry skin, lethargy, exhaustion, headache, muscle weakness, dizziness, a feeling of faintness, and difficulty of focus are all common signs of mild to moderate dehydration. Among males, acute dehydration (1.59% water loss) without producing an increase in body temperature has constrained but discernible impacts on particular perspectives of cognitive execution and causes negative changes in temper, uneasiness, and weariness, which are related to antagonistic changes in cognitive execution in some circumstances. This idea is backed up by the findings in females at a comparative level of lack of hydration (1.39% water loss), which also caused small changes in cognitive execution but significant antagonistic changes in temper. Both genders experienced unfavorable but, to some degree, distinctive behavioral impacts of dehydration below 2% weight loss [21]. Such a little drop in body weight can occur during regular activities [22], illustrating the significance of maintaining ideal hydration. However, people with restorative conditions that can potentially cause a lack of hydration, such as diabetics, along with the elderly and children may be the most likely to encounter antagonistic behavioral impacts of slight dehydration [23].

In Saudi Arabia, the public's awareness of dehydration is low. A prior study of people in Riyadh, Saudi Arabia, to examine dehydration awareness and fluid consumption found that while participants knew the typical symptoms of dehydration, they didn't know the unusual symptoms or significant implications of dehydration [24]. Estimates of dehydration knowledge based on globally published studies may have limited applicability across fields, climates, and cultures. Reporting climate and culturally valid data regarding hydration status and beverage consumption from intermediate and secondary school students might inform Saudi decision-makers, promote health policy, and establish programs that coach students on the importance of drinking healthy beverage. Due to Saudi Arabia's climate changes, and the country's weather becoming increasingly hot [25], we aimed in this study to evaluate the amounts and sources of fluids consumed by adolescents (12-18 years old) in Riyadh schools, Saudi Arabia to determine whether these amounts and sources are enough and appropriate for adequate daily intake.

2. Materials and Methods

2.1. Study design and settings

A multicenter, cross-sectional study was conducted in the governmental schools in five regions of Riyadh City, namely, the north, south, east, west, and central regions. An online self-administered questionnaire was employed for data

collection due to the COVID-19 pandemic.

2.2. Study population and sampling technique

The list of governmental schools in Riyadh City was obtained from the General Directorate of Education in Riyadh City. A stratified random sampling technique was used to select the schools (Boys' and girls' sections) according to the geographical area of each region. Two levels of stratification were used, the region strata (North, South, West, East, and Central) and gender strata (Male and female). Accordingly, a total of 20 schools were selected from the five regions (4 from each region, 2 male schools, and 2 female schools). Then a non-random sampling technique of children's parents was used to recruit the adolescents aged between 12-18 years (secondary and intermediate students). The schools' administrations were contacted and asked to provide us with parents' WhatsApp groups to disseminate the study questionnaire. All students were invited to participate after the parents confirmed that children met the eligibility criteria described on the cover of the questionnaire.

The inclusion criteria were Saudi students aged between 12 and 18 in the designated schools. Any student who complained of significant medical diseases like renal failure, renal tubulopathy, diabetes insipidus, diabetes mellitus, chronic diarrhea, or cystic fibrosis was excluded from this study.

2.3. Data collection instrument

Due to the COVID-19 pandemic, an online questionnaire was employed for data collection and sent to the parents through parents' WhatsApp groups between March 2021 and June 2021. The parents were asked to assist their children in evaluating their children's consumption of beverages. Incorporating the parents helped us minimize the bias of children's comprehension of the study questionnaire.

This study survey was designed based on detailed literature reviews[25][26][27]. Two of the study team members are experts in nephrology care. The first part of the survey consisted of the demographic and clinical data of the students. The second part assessed the amounts of beverages consumed, including water, juices, milk, coffee, tea, and soda. In this questionnaire, we used images labeled with the size for each type of beverage to facilitate children's comprehension of the survey questions and reach as accurate an evaluation of beverage consumption as possible. The last part assessed the knowledge of the recommended amount of beverage intake per day.

2.4. Sample size calculation

Based on the literature, the prevalence of inadequate hydration in the USA is 54.4% (11), as well as an estimated 288,125 Saudi students in governmental schools at the secondary and intermediate stages [28]. The current study sample size is = [/2 ∗ /(∗)]. = estimated prevalence = 0.54, = 1 – = 0.46, = estimating allowable error in the prevalence (margin of error) = 10% on either side of the stated prevalence of 54.4% = 0.054; otherwise, the power of the study = 90%, = probability of type I error = 0.05 (two-sided), = 1.96; therefore, = 1,497. With a nonresponse rate of 10%, the

number of respondents needed for the study was 1,647 students.

2.5. Statistical analysis plan

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0 (Inc., Chicago, IL, USA). Descriptive statistics (mean, standard deviation, and percentages) were used to summarize the participants' characteristics and distribution of total beverage consumption. T-tests were used to compare the means of beverage consumption. A -value less than 0.05 was considered to indicate significance.

2.6. Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board of King Fahad Medical City (19-465). The questionnaire included a cover letter with informed consent indicating that completion of the questionnaire implies their informed consent to allow their children to participate in the study. Official approval was obtained as well from the General Directorate of Education in Riyadh, Ministry of Education. Participants' identities were not captured.

3. Results

A total of 1647 online invitations were distributed, and 1548 participants responded and completed the questionnaire with a response rate of 94%. The mean age of participants was 15.69±1.68, and the majority (1345, 86.9%) were between the age group 14-18 years. Nearly two-thirds (1010, 65.2%) were females. Participants were stratified by gender and age, and the majority (907, 58.6%) were females aged 14-18 years, followed by males (438, 28.2%) aged 14-18 years. The majority of respondents (1102, 71.2%) were from secondary schools, and 25 (1.6%) had significant medical conditions. Table 1

Table 2 shows that beverage consumption was higher in children aged 14-18 years compared to children aged 12-13 years, with a statistically significant difference (p=0.007). Males' beverage consumption (2238.53±879.96) was higher than females' (1918.88±796.01), with a statistically significant difference (p=<0.001). Furthermore, male children in both age groups consumed more beverages than female children in the corresponding age group, with statistically significant differences (p=<0.001; for both). The stratification of beverage intake among secondary and intermediate students showed no statistical difference (p=139). Table 22

Beverage Consumption

For water consumption, males consumed a higher amount (1209.59±534.31) than females (1124.94±548.36), and those aged 12-13 years (1051.77±529.92) reported less water intake than children aged 14-18 years (1169.84±545.58). Tabulation of water consumption showed statistically significant differences with age (p=0.004), gender (p=0.004), gender by age (p<0.001), and school stage (p=0.005) Table 3.

Boys (206.69±224.30) were significantly consuming more juice than girls (123.76±149.83). Younger adolescents aged 12-13 years (204.93±203.38) were drinking more juice than those aged 14-18 years (144.68±179.04), and the intermediate school age (180.27±196.98) were consuming more juice than the secondary school age (141.38±176.59). Tabulation of juice consumption showed statistically significant differences with age, gender, gender by age, and school stage (p= <0.001; for all).

The results show less milk intake among children aged 14-18 years (138.88±198.01) compared to those aged 12-13 years (177.34±200.20). Boys (166.17±223.67) were drinking more milk than girls (132.08±182.97), and secondary school children (133.21±188.61) were consuming less milk than the children at the intermediate school (170.40±219.55). Tabulation of milk consumption showed statistically significant differences with age, gender, gender by age, and school stage (p=<0.010; for all) Table 3.

The results show higher coffee intake among children aged 14-18 years (206.84±234.29) compared to those aged 12-13 years (78.68±140.71). Girls (208.71±236.60) were drinking more coffee than boys (158.36±206.54). Stratification of age and gender showed that girls in both age groups consumed more coffee than boys. Moreover, children in the secondary school (213.25±240.81) consumed more coffee than those in the intermediate school (136.77±180.99). Tabulation of coffee consumption showed statistically significant differences with age, gender, gender by age, and school stage (p= <0.001; for all) Table 3.

Table 3 shows higher tea intake among children aged 14-18 years (170.11±227.10) compared to those aged 12-13 years (132.02±169.78). Boys reported higher tea consumption (202.364±256.02) than girls (147.72±202.36). Stratification of age and gender showed that boys in both age groups consumed more tea than girls. Tabulation of tea consumption showed statistically significant differences with age (p=0.024), gender (p=<0.001), and gender by age (p=<0.001). Coca consumption was significantly higher among male children (299.94±351.29) than females (181.66±314.07). Stratification of age and gender showed that boys in both age groups consumed more coca than girls (p<0.001).

4. Discussion

The current study aims to describe beverage consumption and its variation by age. The results show significant differences in the quantity and pattern of beverage consumption across the age and sex groups examined. The total mean fluid intake for males aged 12-13 years was 2011 mL/day, which is lower than the WHO recommendation for adequate intake for adolescents (9-13 years old), which is 2,400 mL/day [20]. For females of the same age group, the mean fluid intake was 1756 mL/day, also lower than the WHO recommendation of 2,100 mL/day [20]. For other age groups (14-18 years), males' mean fluid consumption was 2291 mL/day, lower than the WHO recommendation of 3,300 mL/day, and for females aged (14-18) years, it was 1937 mL/day, also lower than the WHO recommendation of 2,300 mL/day. Sui et al. (2016) mentioned that the mean daily total water intake for children and adolescents (2-18 years old) is 1.7 for boys and 1.5 L for girls [29]. Kant and Graubard (2010) mentioned that the adjusted mean intake of water in Americans aged 6-11 and 12-19 years is 1.6 L and 2.4 L, respectively. In particular, the average total water intake is insufficient; in general, the

intake of boys was the least adequate [30]. Moreover, Kenney and Long (2009) mentioned that insufficient hydration is widespread among American children and adolescents, especially boys. Proper intake of water can reduce the risks of inadequate hydration [11].

According to our findings, water was the most significant contributor to fluid consumption (Males 1125 mL/day, Females 1210 mL/day), which is similar to the study published by Duffey et al. (2012) [26]. Moreover, Guelinckx et al. (2015), in a study on water and beverage intake among children and adolescents in 13 countries (from Latin America, Europe, and Asia), showed that across all the samples of these countries, the highest daily intake was observed for water, followed by milk, regular soft beverages, and juices [31]. One remarkable point throughout this analysis is that Coca drinks were the second contributor of fluids (Males 300 mL/day, Females 182 mL/day), followed by Coffee drinks (Males 158 mL/day, Females 209 mL/day), then Juice with (Males 207 mL/day, Females 124 mL/day), and the fifth contributor was tea (Males 202 mL/day, Females 148 mL/day), with the lowest being Milk (Males 166 mL/day, Females 132 mL/day). Bello and Al-Hammad (2006) mentioned that Potable water accounted for 37%, whereas fruit juices and carbonated soft drinks accounted for 25% and 26%, respectively [32]. Vieux et al. (2017) reported that the total intake of plain water is 1,338 L/day, the intake of drinking water, coffee, soda, and tea increases with age, whereas the intake of milk decreases. Approximately 88.7% of children do not fulfill the European Food Safety Authority (EFSA) adequate intake criteria. The daily water shortfall ranged from 322 to 659 mL/day. The total water intake was at 74.8% of the EFSA reference standards [33].

The data were collected between February and June of this year 2021 in Riyadh City, during winter to summer seasons. In the summer, the temperature reaches 40-45°C (16). Children in hot regions may be more susceptible to heat sickness than adults because of their larger surface area to body mass ratio, lower rate of sweating, and somewhat slower rate of heat acclimation [34][35]. Children may respond to hypohydration during activity with a larger relative increase in core temperature than adults do, and they may sweat less, reducing the advantages of evaporative cooling. According to Coyle (2004), fluids should be absorbed at rates that are most similar to sweating rates. Whenever that is not feasible, some sportsmen may be able to tolerate body water losses of up to 2% of body weight without affecting their physical well-being or performance when the weather is cold (5-10 °C) or temperate (21-22 °C). When exercising in a hot climate (>30 °C), however, dehydration by 2% of body weight impedes absolute power generation and predisposes individuals to heat injury [36].

This study has some limitations. The study is cross-sectional and based on self-reported beverage consumption. The self-reported drink intake might have been over or underestimated. Furthermore, dietary data are mean values of a 24-hour recall, which is unlikely to be enough time to adequately reflect typical consumption, particularly in children and adolescents, where the ratio of within-subject variability is higher [37]. Selection bias might be present as parents who have limited access to WhatsApp groups or are not interactive using this approach were likely to avoid participation. Measurement bias might be present as well when comparing respondents who were assisted by their parents to respondents who were not assisted by their parents.

Conclusions

This study provides important information about beverage consumption in adolescents. Euhydration is important in maintaining mental and physical function, and dehydration is a risk factor for many health problems. A growing body of data demonstrates the link between fluid imbalances and diseases; however, the evidence is largely associative and inconsistent with a limited number of published research. Tap water is the main source of consumption for all ages, and consumption of other beverages varies by age. The coca drinks came second after water, coffee was third, followed by juice, then tea, and the lowest was milk. The consumption of soft drinks and mainly tap water should be increased.

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