International Journal of Advanced Research and Development
www.advancedjournal.com
ISSN: 2455-4030
Received: 24-06-2022, Accepted: 12-07-2022, Published: 25-07-2022
Volume 7, Issue 4, 2022, Page No. 15-21

Drinking water consumption pattern among Women College students in association with percent body water, proximate nutrients and BMI

Layam Anitha[1*], Ghaida Alqwifel[2], Norah Alaskar[2], Noura Almoneef[2]

[1] Associate Professor, Clinical Nutrition Track, Department of Health and Rehabilitation Sciences, Princess Nora University, Riyadh, Saudi Arabia

[2] Students, Clinical Nutrition Track, Department of Health and Rehabilitation Sciences, Princess Nora University, Riyadh, Saudi Arabia

Abstract
Water is an essential compound and most of body organs depend on water to work properly. No study on exclusively drinking water consumption was reported in Kingdom of Saudi Arabia KSA and hence the present study was carried out to assess drinking water consumption pattern among female college students in association with percent body water, proximate nutrients and BMI. A cross sectional study was conducted in Princess Nourah bint Abdurrahman University. The participants enrolled were 180 students in the age from 18-25 years. Mean water and proximate nutrient intake was collected through questionnaire and selected body composition variables was assessed through Seca body composition analyzer. The study results revealed that the subjects consumed plain drinking water less than their DRI (2.7L/day), and the percent deficit was 93%, 111% and 105% for first day of the week, mid-day and end of the week respectively. The mean consumption in liters was 1399±729.9, 1277.7±681.8 and 1315.5±669, respectively. There was a positive relationship between drinking water consumption and percentage body water with p-value 0.9155 which is not significant. The mean water intake was not strongly correlated with BMI with r-value of 0.0425. Total body water has a negative relationship with energy, carbohydrates and fat, and positive with protein which are weak correlations and not significant. The participants are consuming less water than their requirements, although they are aware about the water benefits to their health. This study is first of its kind in KSA and will give an insight in framing intervention policies to enhance the water intake.

Keywords: water, BMI, proximate nutrients, DRI, Total body water percentage

Introduction
Water is an essential compound for all organisms. Water covers more than two-thirds of the earth's surface. Water composition is two hydrogen atoms and one oxygen atom. Body cannot survive few days without water. Human body mass contains 50-60 % of water. All the organs in body have water, but percentage varies from organ to another due their function. Brain has 74.5%, muscles 76%, kidney 83%, blood 83%, bones 22%, and skin 70% [1]. Infant body consist 75 % of water, and 55% of elderly body weight consist of water, and it is important for cellular homeostasis and life [2]. Water requirement changes according to many factors like age, gender, climate, degree of physical activity, and illness. Established Dietary Reference Intake DRI values are based on water obtained from plain drinking water, water from other beverages, and water from foods [3]. Adequate intakes for water are defined based on observed water intakes in various population groups' desirable water volumes per 1000 kcal, and desirable osmolality values in urine [3]. General requirement for adults is 3.7 liters per day for male, and 2.7 liters per day for female [4].

Most of body organs depend on water to work properly. Drinking plenty of water will helps body to control temperature, waste excretion, prevent constipation, and achieve many other important functions. Average drinking water consumption in UK was 1.138 liters per day [5], in USA men consumed an average of 3.46 liters per day, and women consumed 2.75 liters per day [6]. According to the literature review all the studies focused on the total fluid intake in general and water as a therapy for reducing weight. Epidemiological data suggest that water may have different metabolic effects when consumed alone rather than as a component of flavored, sweetened or caffeinated beverages, but available evidence remains inconclusive [7]. Drinking plain water instead of caloric beverages helps to reduce dietary energy density, and may contribute to the regulation of bodyweight [8]. Some studies have also suggested that consumption of plain water is associated with better diets and better health behaviors [9]. No studies have investigated Total Water Intake and its adequacy amongst adults in the Middle-East, a region that is characterized by a hot climate, a high prevalence of dietary inadequacies in young adults and one of the highest burdens of overweight and obesity in KSA. There are no studies focusing on the plain drinking water among Gulf countries.

In this context, our study will be first of its kind to assess the pattern of drinking water consumption in association with percent body water, proximate nutrients and BMI. The aim of our research is to study the water intake among Princess Nourah University, Health and Rehabilitation Sciences college students and assess the association among water consumption, percentage body water, nutrient intake, and BMI. It is hypothesized, that drinking water consumption among University students is less compared with DRI and there is a relation with percent body water. The present study will give a preliminary database on the drinking water consumption pattern. This study results will help future researchers to plan intervention or awareness programs to the studied population based on the outcome of the study.

Methodology

This study was a cross-sectional study with a total sample of 180 university women students, since the university is women's university. A subsample for dietary intake (n=30) and for body analyzer (n=60) was recruited for the study from the total sample. Data was taken from a self-administered structured questionnaire by google forms, along with body composition analyzer, and 24 hr recall. The seca mBCA 515 is a medical Body Composition Analyzer, which is ideally adapted to the working conditions in hospitals and medical practices. The machine gives a truly meaningful BIA measurement (bioelectrical impedance analysis), with many technical paramaters. In addition to height and weight, additional parameters such as fat mass, body water, and muscle mass will assist your diagnosis or recommendation for therapy. Questionnaire includes: Demographic profile (Name, age, level of study…etc.); Drinking water consumption (Quantity, weather affects, etc.); Reasons for drinking water (Type of water, quality, etc.); Relation between health and drinking water consumption (Negative health conditions, reducing weight, etc.). The 24hr recall includes: Actual water intake in spring and moderate climate was assessed to know the consumption of drinking water. Body composition analyzer (Seca), was used to measure the weight, BMI, body water percentage, fat percentage.

Data was entered and processed before the analysis. Missing data was not computed for analysis. Data analysis was carried by SAS/JMP for descriptive and analytical statistics. JMP (pronounced "jump") is a suite of computer programs for statistical analysis developed by the JMP business unit of SAS Institute. Numerical data was analyzed for descriptive statistics and frequency tables which were used to calculate the drinking water consumption pattern. Relationship and Associations for categorical variables were carried out by Chi-Square, Analysis of variance. All the tests were considered significant if the p-value is<0.05.

This study was conducted after ethical approval by IRB using 24 recall, self- administered structured questionnaire, and body composition analyzer. There was no personal information that was taken from any of the participants. All participants were provided with a consent form before starting the data collection that gave them the information about the study and its aim as well as the option to refuse or to take part in the study.

Results

The age of the sample for the present study ranges from 18 to 25 years. The drinking water consumption pattern of the sample was presented in Table 1 and it is evident that 72.2% of students responded that they prefer to drink water than any other fluid. Regarding water consumption approximately 58.3% responded that they consumed 1-3 bottles of 330 ml each, followed by 27.8% consumed 4 to 6 bottles. Out of the total sample 53.3% preferred to take coffee or tea apart from water, followed by juice 29.4%, Milk 9.4% and soft drinks 7.8% respectively. About 91% of the sample felt that they must consume more water than what they are consuming. In summer season, 53.9% i.e. half of the sample reported that they consumed 4–6 bottles.

As shown in Figure 1 the higher percent of consumption i.e. 26% and mean 360mL was observed at morning for first day of the week. The same pattern was observed for the other two days of the week i.e. mid and end of week. A significant change for the rest of the day was not observed for the remaining occasions for all the observed days in a week (afternoon, evening, at night). The lowest consumption was before sleep for all the three days was observed which were 187.7 mL, 178.8 mL and 183.3 mL respectively. The mean intake of total drinking water consumption for first day is 1399±729.9 mL, 1277.7±681.8 mL for mid-day and 1315±669 mL for week end respectively which is evident from table 3. The percent deficit of water consumption when compared with DRI (2700 mL for women per day) was more for mid of the week 111%, followed by week end 105% and first day of the week 93% respectively.

It is evident from Table 2 that there is a significant difference between the DRI and mean intake of drinking water by the studied sample. The 't' value was 23.91 (p-value <0.00001) for first, 27.98 and 27.83 for mid and week end days of the week. The difference was statistically significant for all the three days when compared with DRI. The study results reveal that there was no significant difference between the drinking water pattern distribution and also between the days of the week. This is evident from chi square value of 10.3966 and also p-value 0.2382 from Table 3. The mean for the energy intake of the subjects from table 4 is 1328 kcal/day which is low when compare it with Estimated Energy Requirements (EER) for their age group. The mean±SD for carbohydrate, protein and fat intake by the subjects are 179 ± 59, 55 ± 23, 43 ± 15 g/day respectively, and when compared with the DRI, their intake is mostly in the same range.

Table 5 shows the association between BMI and total water intake in 3 days with selected body composition variables. The R-value of selected body composition variables are -0.9056, - 0.8904, 0.9613, 0.8684, 0.9718, 0.7599, - 0.9316, 0.8349,0.7732, 0.5221, 0.0140 and 0.0945 for total water percentage, extracellular water percentage, fat mass, fat mass percent, fat mass index, fat free mass kg, fat free mass percentage, Fat Free Mass

Index (FFMI), Skeletal Muscle Mass (SMM), visceral fat respectively. BMI has a negative correlation with total water percentage, extracellular percentage and fat free mass percentage. All the selected body composition variables in relation with BMI, have a significant p-value (<.0001).

Table 6 shows that there is an association between energy and water intake. The r- value for the total body water percentage and extracellular water are -0.1858, -0.1854 respectively. The same association comes with carbohydrate and water intake. The r- value for the total body water percentage and extracellular water are -0.2250, - 0.2384 respectively, which mean that whenever the water intake increases, the energy and carbohydrate intake reduced. Both total body water and extracellular water percentage have a negative relationship with fat intake with r-value of -0.1665, and -0.1730 respectively. Protein has a positive relationship with total body water and extracellular water with r-value of 0.1830 and 0.1340 respectively. The correlations for total body water and extra cellular water percentage with the proximate nutrients are not statistically significant. The same trend was observed for the mean water intake and BMI with r- value of 0.0425 and with non-significant p-value (0.7471).

Table 1: Descriptive statistics in percentage for the drinking water consumption pattern (n=180)

S.NO	Question	Number	Percentage %
1	Do you prefer to drink water than any other fluid?		
	Yes	130	72.2
	No	50	27.8
2	How many bottles (330 ml) of water do you drink per day?		
	1_3	105	58.3
	4_6	50	27.8
	6_9	18	10
	More than 9	7	3.9
3	If you do not take water what your preference of drink?		
	Juice	53	29.4
	Soft drinks	14	7.8
	Milk	17	9.4
	Coffee-tea	96	53.3
4	Do you feel you should be drinking more water than you currently do?		
	Yes	163	90.6
	No	17	9.4
5	In summer, how many bottles (330 ml) of water you drink?		
	1_3	41	22.8
	4_6	97	53.9
	6_9	27	15
	More than 9	15	8.3
6	In winter, how many bottles (330 ml) of water you drink?		
	1_3	120	66.7
	4_6	41	22.8
	6_9	15	8.3
	More than 9	4	2.2

Table 2: Comparison between the mean consumption of water of each day with DRI (n=180)

S.No	Content	Mean±SD (ml/day)	DRI	t-value	p-value
1	First day of the week	1399±729.9	2700 ml/d	23.91	<0.00001*
2	Mid-day of the week	1277.7±681.8		27.98	<0.00001*
3	End day of the week	1315.5±669		27.83	<0.00001*

Table 3: Comparison between the total water intake and water intake distribution n=180)

	At morning Mean±SD	Afternoon Mean±SD	Evening Mean±SD	At night Mean± SD	Before sleep Mean±SD	Chi-square	p-value
Day 1	360±219.9	292.2±215.9	294.4±247.8	264.4±207.8	187.7±177	10.3966	0.238287NS
Day 2	276.6±220.9	298.8±206.5	268.8±234.7	254.4±219.5	178.8±163		
Day 3	287.7±210.5	288.8±199.6	275.5±222.8	280±203.4	183.3±181.7		

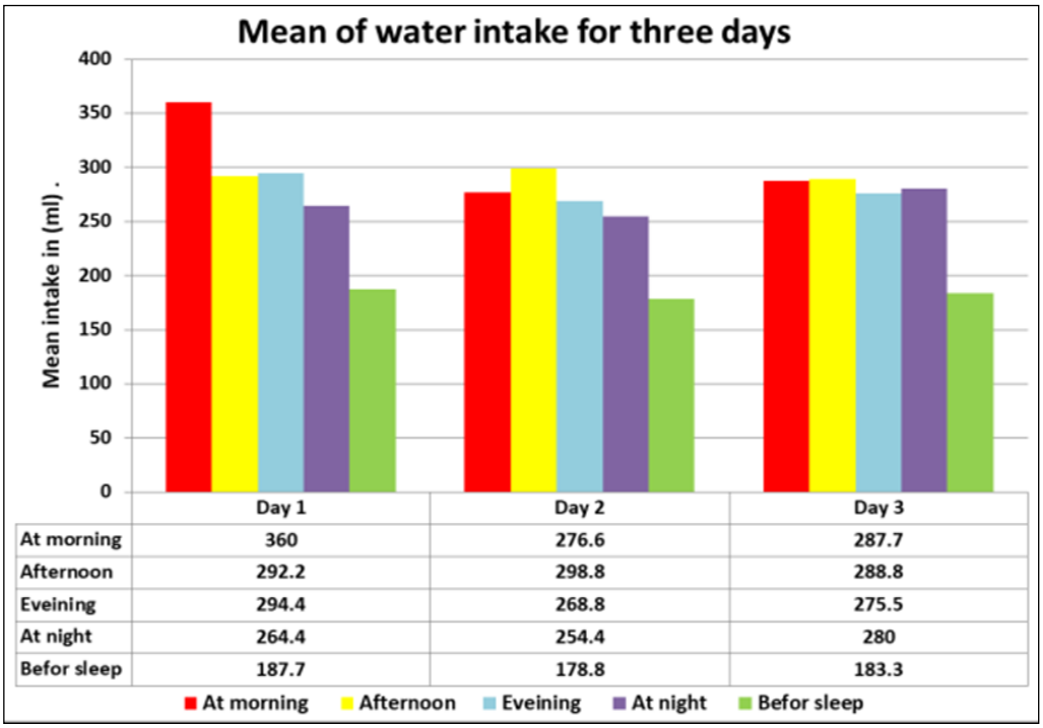

Fig 1: Mean of water intake distribution in week by the sample (n=180).

Table 4: Mean, Standard deviation and DRI for proximate nutrient intake (n=30)

Content	Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)
Mean±SD	1328 ± 379	179 ± 59	55 ± 23	43 ± 15
Estimated Energy Requirements	2200*	130*	46*	(25-35 %)*

* Krause's Food & the Nutrition Care Process, (2014) (12)

Table 5: Correlations between total drinking water consumption, BMI and selected body composition analysis of the subjects (n=60)

	Variables	Correlation "r -value"	p-value
BMI	Total body water percentage	- 0.9056	<.0001*
	Extracellular water percentage	- 0.8904	<.0001*
	Fat mass	0.9613	<.0001*
	Fat mass percent	0.8684	<.0001*
	Fat mass index	0.9718	<.0001*
	Fat free mass Kg	0.7599	<.0001*
	Fat free mass percentage	- 0.9316	<.0001*
	FFMI	0.8349	<.0001*
	SMM	0.7732	<.0001*
	Visceral fat	0.5221	<.0001*
Total water intake in 3 days	Total body water percentage	0.0140	0.9155 ^{NS}
	Extracellular water percentage	0.0945	0.4724 ^{NS}

Table 6: The relationship between total body water and proximate nutrient intake (n=30)

	Variables	Correlation "R-value "	p- value
Energy (Kcal)	Total body water percentage	- 0.1858	0.3255^{NS}
	Extracellular water Percentage	- 0.1854	0.3266 ^{NS}
Carbohydrate (g)	Total body water percentage	- 0.2250	0.2319 ^{NS}
	Extracellular water Percentage	- 0.2384	0.2045 ^{NS}
Fat (g)	Total body water percentage	- 0.1665	0.3793 ^{NS}
	Extracellular water Percentage	- 0.1730	0.3605 ^{NS}
Protein (g)	Total body water percentage	0.1830	0.3330 ^{NS}
	Extracellular water Percentage	0.1340	0.4803 ^{NS}

Discussion

Demographic status, consumption pattern, health and awareness regarding drinking water

Drinking water has heterogeneous effect on body and water consumption and has an effect on energy intake, energy expenditure and fat oxidation. Studies on the consumption pattern of exclusive drinking water by Saudi population studies were meager; however the studies focused on the total fluid intake. The factors that affect the water consumption are age, ethnicity/race, climatic conditions and the health condition of the population. From the present study it is evident that more than half of the subjects (72.2%) preferred to have water as a fluid rather than any other source. Plain water intake significantly differed by sex, weight status, vegetable intake, sodium intake, and physical activity (2014). The proportion of adolescents drinking plain water was less than 2.5 cups/day was the highest among females and who were under normal weight. From the present study it is evident that more than half of sample (58.3%) consumed about ~1000 ml which is the value perceived and reported by subjects [10].

The consumption pattern of drinking water from the present study is on par with the Korean study who consumed 4 cups/day i.e., ~1000 ml/day [7]. The preference of drinks other than plain water was reported mostly (53.3%) for coffee and tea, followed by juice, milk and soft drinks. From a study done in (2016) reported that on national level 74.1% consumed plain water, followed by Non-dairy beverages with sugar (78.9%), dairy beverages with sugar (33.2%), dairy beverages without sugar (27.0%), non-dairy beverages without sugar (10.1%) and natural juices (2.2%) respectively [21]. Plain water consumption showed a positive association with sugar sweetened beverages. In the present study consumption of water intake was mainly focused along in relation to DRI and % body water, and hence data on other drinks reported was peripheral data.

Most of the subjects in the present study (95%) strongly agreed that drinking water consumption is good for their health, and this high percentage suggest that the subjects have more knowledge and awareness about the importance of drinking water consumption for their health. However, the attitude and practicing of drinking water to reach the DRI will be affected by so many factors which have to be studied in depth. Drinking plenty of water is commonly recommended in weight loss regimens and a pervious study done in (2014) measured the effect of drinking 1.5 L of water, over and above the usual intake on body weight, body mass index (BMI), body fat, and appetite score in overweight female participants. The result of the study revealed that drinking 1.5 L of excessive water per day than DRI has a role in weight reduction, body fat reduction, and appetite suppression in overweight female participants [11].

A study done in 1996 reported that dehydration can affect the body health by causing urological, gastrointestinal, circulatory and neurological disorders. In the present study almost all the subjects (93.9%) chosen that dehydration can cause many health complications when losing high amount of water from the body and the electrolyte level will be out of balance. Loss of water by vomiting can lead to loss of hydrochloric acid and sweating can cause a loss of hypotonic fluids [14]. Over hydration can lead to mortality and several morbidity problems such as heart failure, urinary tract abnormalities and hyponatremia [15]. Study done in 2014 stated that drinking excess water suppresses appetite, thus supporting water as a natural appetite suppressant [11]. There was an 30% increase in energy expenditure after drinking water 2003 [16]. From the present study, it is evident that most of the studied subjects agreed that there is a relationship between reducing weight and drinking water consumption.

Water is important in detoxification and elimination of waste components from the body. It is the element in which many of the toxins are excreted from the body. Drinking plenty of water flushes the body systems and helps to excrete waste products. From the present study, mostly (77.2 %) agreed that water can be one of the detoxifying drinks. The salt is absorbed in the body by blood stream, making blood with more sodium and chloride than it was before, and that makes the fluid outside of the body cells saltier than the fluid inside the cells. The cells try to attach to water and they send chemical messengers to the brain to feel thirsty [17]. From present study more than half of sample (63.9%) strongly agreed that with salty foods, the need for drinking water increases.

Drinking water has a glycemic index of zero and an insulin index of zero, and hence water doesn't inhibit the rate limiting biochemical steps for fat breakdown to free fatty acid, transportation of free fatty acid into the mitochondria and fat oxidation, like other beverages which contain carbohydrate or trigger insulin 1997 [18]. From present study 30.6% of the sample agreed that there is a relationship between fatty foods and increase the need for drinking water. The percentage reported from the study was less which can be attributed due to lack of indepth knowledge regarding the biochemical associations between effect of water and body composition variables.

Mean drinking water consumption by the subjects

Water consumption was less than the DRI by the sample from the present study. This less intake by the subjects might be due to lack of knowledge in terms of requirement and satisfying thirst with other drinks and beverages instead of plain water. The mean with-in day water intake occasions for three days were ranging from 178.8±163ml to 360±219.9ml. The difference between the days and with-in the day water consumption distribution was not statistically significant from the present study. Consumption per occasion by the subjects is on par with the study done in 2009 which is 8-10 oz. (approximately 240-300ml) [19]. A study was done in 2013 reported that water intake might change due several factors such as sex, age, weight, diet, health status, exercise condition [20].

Drinking water contribution from the total fluid intake for adolescents from a study done in KSA was 37%. From the present study, if DRI of 2.7L/d is taken as 100%, the mean drinking water intake contributes to about 47% (1249.97±651.65mL). The remaining contribution can be assumed from soft drinks and caffeinated beverages. Factors that influence the need for fluid are exercise, high temperature, low humidity and increased fluid loss due to caffeine consumption [21, 22].

Inter Relationship between Drinking Water Consumption, Bmi, And Selected Body Composition Variables

In the present study, there is a significant (p-value of < .0001) association between BMI and total water percentage, extracellular water percentage, fat mass, fat mass index, fat free mass, fat free mass index, skeletal muscle mass, and visceral fat. A study done in 2016 reported that higher consumption of water was negatively associated with BMI, body fat, fat free mass, waist circumference, and insulin levels [9]. As predicted in our study that when the water consumption increases, percent water distribution in the body has to increase. There are no strong correlations between these two variables, because the subjects are not meeting their DRI requirements. The protein and percent water distribution in body has a positive relationship. This positive relationship was observed from the present study might be due to the fact that water helps carrying important nutrients in solution, so that they can be taken up by muscle tissues in the body. Fat molecules are heterogeneous to water. The present study results show that there is a negative relationship between fat intake and percent water distribution in body. There is a negative relationship between drinking water consumption and energy intake. A study in 2005 reported that drinking water can lower energy intake [23]. The present study could not reveal a strong correlation between the mean water intake and BMI of the subjects. This result may be due to factor that the mean intake was very less than the DRI and also small sample size. These results are not on par with the study done in 2012 where the referred researcher could find significant correlations between total body water and indexes of adiposity [24].

Conclusion

The exclusive drinking water consumption among PNU students is less compared with DRI. There is a relationship between the drinking water intake and total water percentage which is not statistically significant and this may be attributed to small sample size. The present study results reveal that among energy, carbohydrate, protein and fats intake by the subjects only protein showed as positive correlation with total body water and extracellular water percentage. From the present it is evidenced that a strong correlation was not found between mean water intake and BMI. When BMI was compared with selected body composition variables, it showed a negative correlation with total body water percentage, extracellular body water percentage and fat free mass percentage which are statistically significant. The study shows that whenever drinking water consumption increases the energy, carbohydrates and fat intake will be reduced which is evident by negative correlations. However, with the protein intake, total body water will increase. The study also revealed that participants are aware about the importance of water for their health due to their education output.

References

1. Popkin BM, D'Anci KE, Rosenberg IH. Water, hydration, and health. Nutrition reviews,2010:68(8):439-458. doi:10.1111/j.1753-4887.2010.00304.x
2. Nicolaidis S. Physiology of thirst. In: Arnaud MJ, editor. Hydration Throughout Life.Montrouge: John Libbey Euro text, 1998, 247.
3. Jomaa L, Hwalla N, Constant F, Naja F, Nasreddine L. Water and Beverage Consumption among Children Aged 4–13 Years in Lebanon: Findings from a National Cross-Sectional Study. Nutrients,2016:8(9):554. doi:10.3390/nu8090554
4. Institute of Medicine. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Washinton, DC: The National Academies Press, 2005. https://doi.org/10.17226/10925.
5. Shukla SK. Tap water consumption in England and Wales. Indian Journal of Applied Research,2011:4(5):370-373. doi:10.15373/2249555x/may2014/111
6. Rosinger A, Herrick K. Daily water intake among U.S. men and women, 2009–2012. NCHS data brief, Hyattsville, MD: National Center for Health Statistics, 2016, 242.
7. Stookey JD, Constant F, Popkin BM, Gardner CD. Drinking water is associated with weight loss in overweight dieting women independent of diet and activity, 2008. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/18787524
8. Daniels MC, Popkin BM. The impact of water intake on energy intake and weight status: A systematic review, 2010. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2929932/?ncid=edlinkushpmg00000313
9. Stookey JD, Constant F, Gardner CD, Popkin BM. Replacing Sweetened Caloric Beverages with Drinking Water Is Associated with Lower Energy Intake. Obesity,2007:15(12):3013-3022. doi:10.1038/oby.2007.359
10. Lee HS, Park S, Kim MH. Factors associated with low water intake among South Korean adolescents - Korea National Health and Nutrition Examination Survey, 2007-2010. Nutrition research and practice,2014:8(1):74-80. doi:10.4162/nrp.2014.8.1.74

11. Vij VAK, Joshi AS. Effect of excessive water intake on body weight, body mass index, body fat, and appetite of overweight female participants. Journal of natural science, biology, and medicine,2014:5(2):340.
12. Mahan K, Raymond JL, Escott-Stump S. Krause's food and nutrition care process. Part -1 Nutritional assessment. Elsevier Saundras, 3251, Riverport lane, St.Louis, Missouri, 63043. 13th Edition, 2012, 1-250.
13. Shamah-Levy T, García-Chávez CG, Rodríguez-Ramírez S. Association between Plain Water and Sugar-Sweetened Beverages and Total Energy Intake among Mexican School-Age Children. Nutrients,2016:8(12):710. doi:10.3390/nu8120710
14. Hayfron-Benjamin J, Peters CA, Woodhouse RA. A demographic study of polydipsia in an institution for the intellectually disabled. The Canadian Journal of Psychiatry,1996:41(8):519-522(13)
15. El-Sharkawy AM, Sahota O, Lobo DN. Acute and chronic effects of hydration status on health. Nutrition reviews,2015:73(2):97-(12).
16. Boschmann M, Steiniger J, Hille U, Tank J, Adams F, Sharma AM *et al*. Water-induced thermogenesis. The Journal of Clinical Endocrinology & Metabolism,2003:88(12):6015-6019.
17. Breau A. Why Salt Makes You Thirsty, 2011. Retrieved fromhttps://indianapublicmedia.org/amomentofscience/why-salt-makes-you-thirsty
18. Horowitz JF, Mora-Rodriguez R, Byerley LO, Coyle EF. Lipolytic suppression following carbohydrate ingestion limits fat oxidation during exercise. American Journal of Physiology-Endocrinology And Metabolism,1997:273(4):E768-E775.
19. Barraj L, Scrafford C, Lantz J, Daniels C, Mihlan G. Within- day drinking water consumption patterns: Results from a drinking water consumption survey. Journal of Exposure Science & Environmental Epidemiology,2008:19(4):382-395.doi:10.1038/jes.2008.28
20. Goodman AB, Blanck HM, Sherry B, Park S, Nebeling L, Yaroch AL. Behaviors and attitudes associated with low drinking water intake among US adults, Food Attitudes and Behaviors Survey, 2007. Preventing chronic disease,2013:10:E51. doi:10.5888/pcd10.120248
21. Bello LL, Al-hammad N. Pattern of fluid consumption in a sample of saudiarabian adolescents aged 12–13 years. International Journal of Paediatric Dentistry,2006:16(3):168-173.
22. Kleiner SM. Water: an essential but overlooked nutrient. Journal of the American Dietetic Association,1999:99:200-206.
23. DellaValle DM, Roe LS, Rolls BJ. Does the consumption of caloric and non-caloric beverages with a meal affect energy intake?.Appetite,2005:44(2):187-193.
24. Mehdizadeh R. Relationship between body water compartments and indexes of adiposity in sedentary young adult girls. Brazilian journal of Biomotricity,2012:6:2:84-92.