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REVIEW

Water Consumption: Effect on Energy Expenditure and Body Weight Management

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Abstract

Purpose of Review Water, which is of vital importance, has a critical role in maintaining the normal function of the body, and even mild dehydration can play a role in the development of various diseases. Therefore, it is of great importance to meet the recommended daily water consumption amounts. In addition to the numerous roles of water in metabolism, its effect on energy metabolism should not be overlooked. Water consumption can increase energy expenditure and be an additional tool for weight management. Therefore, the importance of water consumption, which is like a hidden component for treating of obesity, should be emphasized. This review was written to explain the possible mechanisms of water consumption in energy expenditure and body weight management.

Recent Findings Because water consumption is associated with sympathetic activity, which increases metabolic rate (thermogenesis) and daily energy expenditure, the increase in sympathetic activity caused by water consumption is an important and unrecognized component of daily energy expenditure. In addition to the concept of water-based thermogenesis, water, which is a potential improvement factor in body composition, also plays an auxiliary role in body weight loss with both less energy intake and increased fat oxidation. From this perspective, water consumption may have critical importance in the fight against increasing obesity worldwide.

Summary Considering its effect on energy metabolism in various ways, it becomes necessary to focus more on the importance of water on human health.

Keywords Water · Dehydration · Energy expenditure · Obesity · Body weight

Introduction

Water is a basic component for maintaining health and life and has vital importance in terms of its duties [1]. The human body consists of 45–75% water on average [2], and a fluid loss of as little as 1% of body weight increases plasma osmolality, while a 2% loss negatively affects exercise performance, while a 20% loss can be life-threatening [3]. Therefore, water, which is present in every cell and various tissues and organs of the body, is essential for life [1].

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In addition to its basic functions, water increases the rate of lipolysis and energy expenditure by sympathetic stimulation and induction of thermogenesis [4–6]. It is stated that there is a relationship between water consumption and body composition and that sufficient water consumption can improve body composition [7•]. It is quite clear that water consumption, which can be effective in protecting against the worldwide obesity epidemic, is associated with body weight loss [7•]. For possible mechanisms between water and body weight control, it seems likely that water consumption may result in less energy intake and increased fat oxidation [8]. Also, the short-term effects of water consumption include increased satiety and, as a result, decreased feelings of hunger [9].

It is a known fact how important water consumption is for the body. However, little attention has been paid to the contribution of water consumption to energy expenditure and indirectly to body weight management. It is critical to develop new studies that confirm and help this relationship in establishing various measures for public health, because it is possible to increase people's awareness of this issue and thus encourage drinking more water. In this review, it is aimed at examining the effect and potential mechanisms of water consumption on energy expenditure and body weight.

Functions of Water in the Human Body

For the human body, water has a wide variety of essential functions for the body, such as digestion and metabolism of energy and nutrients, transport of nutrients and metabolites to cells, and excretion of waste products, maintaining electrolyte balance, maintaining thermoregulation, and providing a fluid environment for the developing fetus [10]. The loss of water from the body through sweat functions as an important cooling mechanism in hot climates and during physical activity [11]. Water is required for cellular homeostasis, transports nutrients to cells, and removes waste from cells [1]; it also clears toxins and carries oxygen to cells [12]. Water also protects the body from dehydration, which is a serious problem. There are several simple indicators of dehydration that mainly refer to the loss of body water from the intracellular fluid (ICF). Examples of these are dark urine color, dizziness, confusion, and tachycardia [13]. Most importantly, about 20% loss of total body water (TBW) can result in death [10]. Because of all these, water is so important to human life that although it is possible to survive for several weeks without eating, life cannot be sustained if water is not consumed for more than a few days [2]. The functions of water in the body are summarized in Fig. 1.

Daily Water Consumption Recommendations of Various Authorities

The human body consists of water between 45 and 75% of body weight, depending on several factors such as age, gender, and body composition [2], and TBW is distributed between the ICF and extracellular fluid (ECF) compartments. Physiologically, 55–65% (about 2/3) of TBW is in ICF, and 35–45% (about 1/3) is in ECF. About 3/4 of the ECF is composed of interstitial fluid, and 1/4 of it is intravascular fluid (blood volume), while the adipose tissue contains approximately 30% water and lean tissues 70–80% [14, 15].

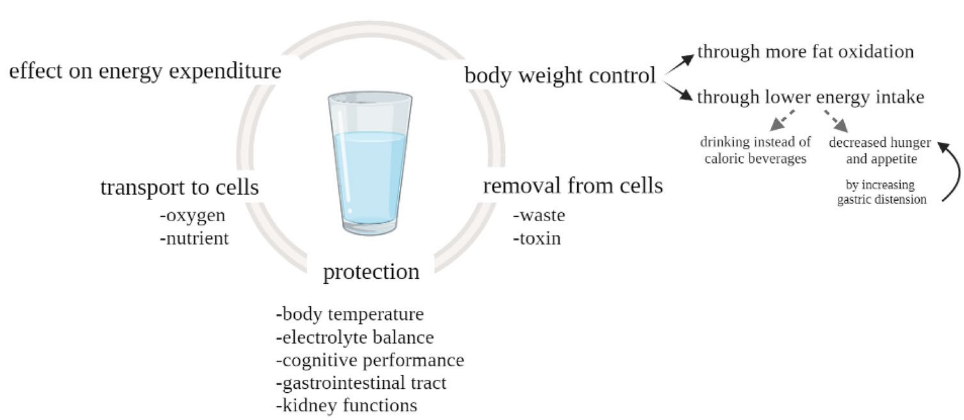
Many systems in the body are constantly working to maintain the optimal health with normal physiological functions, carry the necessary substances to the cells, and maintain internal homeostasis. Variables that are part of body water homeostasis include water loss through urine, sweat, transdermal, respiration, and feces, and there are some differences in these variables, and therefore, human body water regulation is highly dynamic [16••]. Since endogenous water is not sufficient to balance water loss, a sufficient amount of water must be consumed exogenously through the diet [12].

The daily water needs of individuals vary greatly depending on many factors such as age, gender, physical activity status, climate, diet, and body mass index (BMI) [2, 17]. It is critical to meet the daily water requirement for the optimal functioning of the body [1]. Both the European Food Safety Authority (EFSA) [18] and the Institute of Medicine (IOM) [19] have published gender- and age-specific recommendations on water consumption. EFSA [18] recommends 2.5 L/day for adult men and 2 L/day for women, and IOM [19] and, on the other hand, recommends 3.3 L/day for men and 2.3 L/day for women [20]. Notably, the consumption of foods with high water content, such as fruits and vegetables, can contribute to increased daily fluid intake and ultimately increase hydration [21]. However, there is also a recommendation for the total amount of energy consumed (kcal) for water consumption, which is 1.5 mL/kcal for infants, 1.2 mL/kcal for children, 1 mL/kcal for adults, and 1.1 mL/kcal for the elderly [18].

In the recommendations of both authorities, total fluid intake (including water) and water from food are included in total water consumption, because water consumption mainly includes drinking water and beverage consumption (80%) and water contained in food (20%) [18, 19].

However, these proportions are not fixed and depend on the type of beverage and the choice of food. Considering the contribution of food to daily water consumption, it is

Fig. 1 Primary functions of water (created with BioRender.com/)



known that this varies depending on the type of food. When the water content of some food types is examined, it is seen that it is generally below 40% in bakery products, between 40 and 70% hot meals, > 80% in fruits and vegetables, and approximately 90% in both human and cow's milk. Therefore, diets rich in vegetables and fruits provide significant amounts of total water intake, while fast food products have a low contribution to daily water consumption due to their low water content [18].

However, EFSA and IOM have taken slightly different approaches in setting their recommendations. The difference between the proposals of the two institutions depends on the methodology used and the environmental and population characteristics of the countries. EFSA established the AI values considering three factors: the observed intakes of the European population, the desired urinary osmolality values, and the total recommended water intake per unit of energy consumed (kcal). However, EFSA recommends that the established AI values only be applied at moderate ambient temperature and physical activity levels [18], because the contribution of sweat to water loss is higher in physically active people and in hot climates. Therefore, this component is highly variable depending on the individual's lifestyle and environmental conditions [22]. The IOM has determined AI values based on median intakes observed in national surveys, which forms the basis for recommended daily amounts. The population intake data used by the IOM, though climatically diverse, is a single dataset generated using the same methodology [19].

Elderly people are at a greater risk of dehydration due to many reasons such as a decrease in the thirst sensation, some physical disabilities that limit access to fluid intake, polypharmacy, and neurocognitive deficiencies [23, 24]. Additionally, they are mostly unaware that dehydration can cause dreadful problems, including death. Therefore, it should be underlined that the elderly should be warned that paying attention to hydration will reduce the risk of mortality and morbidity [24].

Effects of Water Consumption on Energy Expenditure

Because thermogenesis is partially regulated by sympathetic activity, substances that interact with the sympathetic nervous system can be considered potential agents for body weight loss [25]. Sympathomimetic compounds such as ephedrine are effective in increasing thermogenesis, but they can also cause undesirable side effects [26]. Therefore, safe, preferably non-pharmacological substances that can stimulate thermogenesis without causing side effects come to the fore. A surprising candidate for a thermogenic agent is water, one of the most important of all essential substances for life [27]. On average, the consumption of 500 mL water significantly and rapidly increases sympathetic activity with increased plasma norepinephrine levels [28].

The first study to prove the concept of water-induced thermogenesis was performed by Boschmann et al. [5] on 14 (7 men, 7 women) healthy, normal body weight individuals. In this study, in which the effect of 500 mL water consumption on energy expenditure using indirect calorimetry was evaluated, it was observed that 500 mL water consumption increased the metabolic rate by 30%. The increase occurred within 10 min and reached a maximum of 30–40 min. The total thermogenic response was about 100 kJ. This increase in resting energy expenditure (REE) was reduced when a beta-adrenoreceptor blocker was given. This suggested that the sympathetic system was responsible for this increase in energy consumption. In this study, it was stated that the consumption of 2 L of water per day would increase the energy expenditure by approximately 400 kJ [5]. Another study was planned by the same study group to test whether water consumption would provide the same thermogenic effect in obese as in normal-weight individuals, and 16 (8 men, 8 women) overweight or obese individuals were included in the study. After the consumption of 50 mL, 500 mL, and isosmotic saline at 22 °C, it was determined that while isosmotic saline and 50 mL water had no effect, it increased energy expenditure by 24% 60 min after consumption of 500 mL water. This finding suggests that the REE-enhancing effect is osmosensitive and not only associated with gastric distension [4].

Another study showed that an increase of ≥ 1 L per day in drinking water was associated with a loss of approximately 2 kg of body weight over 12 months [29]. A body weight loss of 2 kg is consistent with experimental data showing that 500 mL of drinking water increases energy expenditure by 100 kJ [5].

However, these findings could not be replicated by the different study groups. In another study by Brown et al. [27] to test whether water consumption has a thermogenic effect in humans and also to determine whether this is affected by osmolality or water temperature, individuals were given 7.5 mL/kg body weight of distilled water or 0.9% saline or 7% sucrose solutions were given on different days. REE as assessed by indirect calorimetry was measured 30 min before and 90 min after the drinks. As a result, energy consumption did not increase after distilled water or 0.9% saline consumption, whereas 7% sucrose solution significantly increased energy consumption. Drinking water cooled to 3 °C resulted in a small 4.5% increase in energy consumption for 60 min ($p < 0.01$). For 90 min, 7% sucrose solution REE increased 33 kJ, and water consumption chilled to 3 °C increased 15 kJ. As a result, the consumption of distilled water at room temperature did not increase energy consumption, while cooling the water before drinking caused only a minor thermogenic effect [27]. It is thought that this difference between studies may be due to differences in REE measurement techniques or other methodological issues, because water-induced thermogenesis can also be caused by substances dissolved in water. Boschmann et al. did not specify whether the water they used was tap water, bottled water, or distilled water in their studies. However, tap water and bottled water contain a number of dissolved electrolytes that can induce a thermogenic effect. However, this possibility was excluded using distilled water in the study by Brown et al. [27].

It was emphasized that water-borne thermogenesis should be tested in the pediatric population, and a study was conducted in this context [30]. In this study, an increase of up to 25% in REEs lasting more than 40 min after consumption of 10 mL kg^{-1} cold water at 4 °C in overweight children was shown, and it was observed that consuming the recommended daily amount of water for children was approximately 1.2 kg of additional body weight per year. It has been stated that it can cause an energy expenditure equivalent to the loss of energy. These findings reinforce the concept of water-induced REE elevation shown in adults. Again, in a school-based intervention study that supported water consumption to prevent excess body weight, a 31% reduction in the prevalence of overweight was noted among the participants over 1 year with the support of water consumption [31].

Water consumption-induced thermogenesis is an important and unrecognized component of daily energy expenditure. Therefore, this complementary intervention is seen as a useful adjunctive therapy to achieve an increase in energy expenditure in overweight and obese individuals [6].

Effects of Water Consumption on Body Weight Control and Body Composition

Water consumption is effective in body weight loss through two main mechanisms, less energy intake and more fat oxidation [32].

Water Consumption Is Associated With Less Energy Intake

Drinking more water is recommended as a way to reduce body weight gain, as water consumption can replace high-energy drinks and reduce the total amount of energy consumed [33].

Sugar-sweetened beverages are a significant contributor to the risk of obesity, along with excessive body weight gain, due to their high added sugar content, low feelings of satiety, and promoting excessive energy intake [34]. The consumption of these beverages results in excessive energy intake because individuals do not reduce the amount of food consumed to compensate for the high energy in the beverages [35, 36]. Results from a study show that high-energy drinks provide a significant amount of energy to a meal without affecting satiety and are likely to contribute to excessive energy consumption [35]. Therefore, to eliminate the excess energy from these drinks, it is possible to replace these drinks with drinking water. There are strong indications that adopting such a dietary pattern can be an effective way to reduce energy intake [35, 37].

As a result of a study, replacing all energy-containing sugar-sweetened beverages with drinking water was associated with an estimated decrease of 200 kcal/day energy intake over 12 months, and it was emphasized that replacing high-energy beverages with drinking water could be a way to reduce energy intake [37] and, in another study reporting this effect, consuming the same foods at meals; however, it has been shown that those who consume high-energy drinks as beverages do not reduce the food they consume at the meal compared with those who consume water, and as a result, the energy they receive from the same meal is higher [38]. It is stated that replacing all sugar-sweetened beverages with water can result in an average reduction of 235 kcal/day [39]. Therefore, replacing high-calorie sugar-sweetened beverages with water appears to be an effective strategy to reduce energy intake.

In a study examining the effect of water consumption on body weight loss in obese elderly people, individuals were divided into two groups as those following a hypocaloric diet and those who drank 500 mL water before meals in addition to a hypocaloric diet. After a 12-week follow-up period, it was reported that those who consumed 500 mL water before meals lost 2 kg more body weight compared with those who only followed the hypocaloric diet [40].

At the same time, the short-term effects of water consumption include increased satiety and, consequently, decreased hunger [9]. In a study on this subject, it was stated that increased water consumption was associated with suppression of hunger in individuals with normal body weight [41]. In this context, some studies have shown that premeal water consumption, especially in elderly individuals, provides a reduction in energy intake, and therefore, it is stated that it can be an effective body weight control strategy [42, 43]. Popkin et al. [20] reported that daily energy consumption in the general adult population who drank 1530 mL water was approximately 194 kcal/day less than those who did not drink water [20].

Therefore, it seems likely that hypohydration is associated with lower fullness [44]. Extra 1500 mL of water consumption per day for 8 weeks provided a significant decrease in the appetite scores of the individuals [45]. Hypohydration may affect gastrointestinal function, affecting feelings of fullness and food intake [44]. An increase in gastric distension can be considered to be a possible mechanism associated with the effect of water consumption on appetite. Distention may increase after water consumption [46], and there is a potentially direct, inverse, and causal relationship between gastric distension and appetite (mainly satiety) [47]. The fullness ratings rose, and hunger ratings declined for women whose gastric balloon were inflated [48]. Sturm ve ark. [46] stated that the decrease in energy intake of water consumed before a meal may be associated with increased distension [46]. At this point, the temperature of the water consumed may also be important. In a study on the subject, healthy men were given 500 mL water at 2 °C, 37 °C, and 60 °C with at least 6 days between them. In the 24 h before the trials, subjects measured and recorded all dietary intakes. In each trial, after 10 h of fasting, 500 mL water at a certain temperature was given at 08.50 and the water was drunk until 09.00. They were then allowed to sit in a fixed position until 10.05, during which a 2D ultrasound scan was performed to evaluate the change in cross-sectional gastric antral region and gastric contractions before and after consuming water. Between 10.05 and 11.05, the test meal was given and they were instructed to eat until they were full. The results showed that gastric contractions and ad libitum energy intake depended on premeal water temperature. It has been reported that consuming 500 mL water 1 h before a meal at 2 °C was more effective in reducing gastric contractions, while the amount of energy taken was the least after consumption of water at 2 °C ($p < 0.05$). Additionally, the subjective perception of appetite also tended to be lower after consuming water at 2 °C compared to 60 °C. Current findings also suggest that cold-water-induced reduction in energy intake appears to be associated modulation of gastric motility [49].

Water Consumption Is Associated With More Fat Oxidation

Fat oxidation (lipolysis) is a corresponding concept as long as triglycerides are hydrolyzed to glycerol and free fatty acids [50]. Insulin, on the other hand, inhibits rate-limiting enzymes that break down triglycerides into free fatty acids, transport free fatty acids to mitochondria, and provide oxidation by the Krebs cycle. Drinking water, on the other hand, does not trigger insulin like other beverages, as it does not contain macronutrients like other beverages. Because fat oxidation is maximum when blood insulin levels are low, a lower glycemic response to drinking water is also associated with a higher rate of fat oxidation [32].

Physiologically, increased water consumption leads to an increase in blood volume with a concomitant increase in right atrial pressure. This leads to the release of atrial natriuretic peptide (ANP), the first identified peptide of the natriuretic family [51, 52]. The receptor target of natriuretic peptides is natriuretic peptide receptor A (NPRA), a membrane-bound guanylyl cyclase [53], and binding of ANP to NPRA on adipocytes leads to the production of intracellular second messenger cyclic guanosine monophosphate (cGMP). Increased intracellular cGMP levels activate cGMP-dependent protein kinase G (PKG), which induces lipolysis through the phosphorylation of hormone-sensitive lipase [53, 54]. PKG-mediated phosphorylation triggers a cascade of enhanced lipolysis, and activation of p38 mitogen-activated protein kinases (p38MAPK) stimulates thermogenic programs in brown adipose tissue [53]. It also activates mitochondrial biogenesis of AMP-activated protein kinase (AMPK) and p38MAPK, leading to the browning of white adipose tissue [54].

It has been observed that short-term intravenous administration of ANP acutely increases lipid oxidation [55, 56] and postprandial energy expenditure in healthy men [56]. cGMP also induces a peroxisome proliferator-activated receptor-gamma coactivator (PGC-1α). Activation of PGC-1α increases the activity of peroxisome proliferator-activated receptors (PPARs), which have a transcriptional activity on genes involved in lipid oxidation and mitochondrial function.

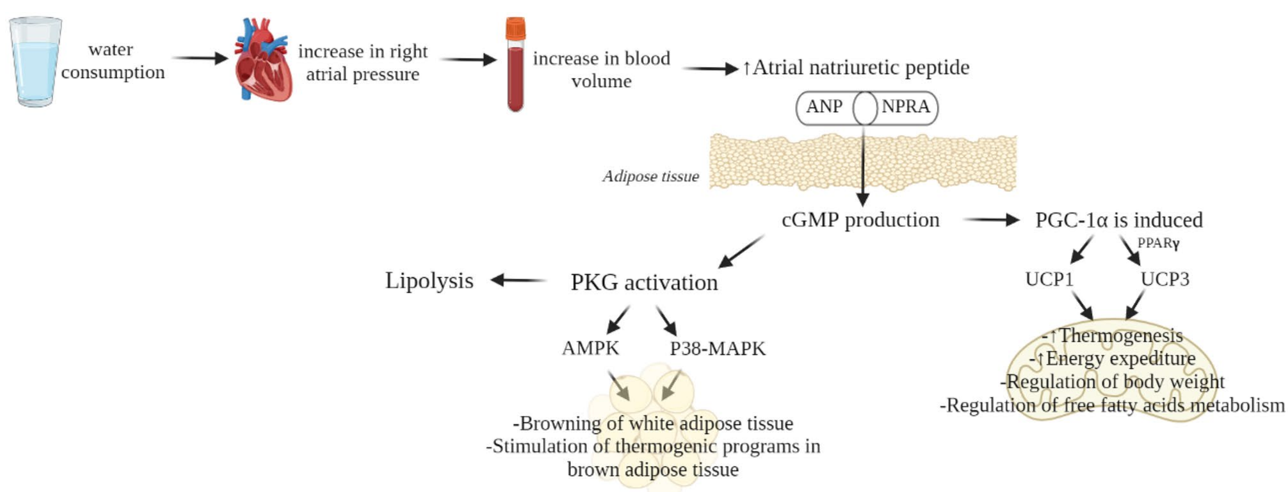


Fig. 2 The effect of water consumption on energy metabolism via fat oxidation. ANP—atrial natriuretic peptides; NPRA—natriuretic peptide receptor A; PKG—protein kinase G; AMPK—AMP-activated protein kinase; P38-MAPK—p38 mitogen-activated protein kinases; PGC-1α—peroxisome proliferator-activated receptor-gamma coactivator; PPAR-γ—peroxisome proliferator- activated receptor gamma; UCP—uncoupling protein. Created with BioRender.com

Table 1 Summary of some studies on the effect of water consumption on energy metabolism and body weight

Authors, year	Participants	Methods	Results	References
Boschmann et al. (2007)	8 overweight or obese 8 healthy subjects	After a certain rest period, all participants were tested with each drink, using 500 ml of isoosmotic saline or 50–500 ml of water in a random, crossover fashion. Measurements continued for 90 min after the test.	Only 500 ml of water increased energy expenditure by 24% for 60 min after drinking, while isoosmotic saline and 50 ml of water showed no effect.	[4]
Boschmann et al. (2003)	14 normal weight subjects	The participants were given 500 ml of water, and the measurements were continued for 90 min.	Drinking 500 ml of water increased the metabolic rate by 30%. While the increase was within 10 min, it reached the maximum level in 30–40 min. It has been stated that 2 L of water per day will support the energy consumption of approximately 400 kJ.	[5]
Stookey et al. (2008)	173 premenopausal overweight women (aged 25–50 years) who reported < 1 l/day drinking water	An education was given for 2 months, and diet, body weight, and composition were evaluated at baseline, 2 months, 6 months, and 12 months of the participants.	Increasing in drinking water to ≥ 1 l/day for 12 months was associated with approximately 2 kg body weight loss.	[29]
Stookey et al. (2007)	118 overweight women who regularly consumed sweetened caloric beverages (> 12 oz/d)	An education was given for 2 months, and the dietary intakes and body compositions of the participants were recorded at baseline, after 2 months of training, and at 6 and 12 months.	Replacing all sweetened caloric beverages with drinking water was associated with an estimated mean of 200 kcal/d reduction in total energy over 12 months.	[37]
Dennis et al. (2010)	48 overweight or obese subjects (aged 55–75 years)	Participants were assigned to one of two groups as hypocaloric diet + 500 ml water prior to each daily meal (water group), or hypocaloric diet alone (nonwater group). The effect of this application on energy intake at meals and thus on body weight loss for 12 weeks was investigated.	Weight loss was approximately 2 kg more in the water group than in the dehydrated group, and 44% more weight loss was observed in the water group compared to the dehydrated group over 12 weeks. It has been stated that drinking about 2 glasses of water before each of the three main meals can increase body weight loss.	[40]
Vij and Joshi (2014)	50 overweight female participants	During 8 weeks, 500 ml of water was consumed 3 times a day before breakfast, lunch, and dinner. Body fat was calculated using skinfold thicknesses from three regions.	At the end of the process, the body weight, sum of skinfold thickness and body fat, and the appetite score of all participants decreased significantly.	[45]

PGC-lα also induces mitochondrial uncoupling protein (UCP) 1 in adipose tissue and UCP3 in skeletal muscle through interaction with PPARγ [54]. These proteins have functions such as thermogenesis and energy expenditure (UCP1) and regulation of free fatty acid metabolism (UCP3) [57]. In addition to its effect on thermogenesis, UCP1 is central to the regulation of energy balance and body weight [58]. See Fig. 2.

Effects of Water Consumption on Body Composition

The World Health Organization (WHO) considers the consumption of sugar-sweetened beverages a possible contributor to chronic diseases [59]. Prospective evidence shows a trend toward a positive association between the consumption of sugar-sweetened beverages and the risk of being overweight [60, 61]. In addition, such drinks pose a risk for various health problems by causing an increase in body fat [62]. Therefore, it is thought that increasing water consumption instead of sugar-sweetened beverages will have a positive effect on body composition as well as body weight loss.

Achievement of the absolute and relative increase in drinking water has been associated with significant fat loss over time [29]. In a study conducted with children aged 9–11, a higher amount of water consumption per body weight was found to be inversely related to both body fat and lean mass [63].

In a longitudinal follow-up study on this subject, overweight individuals were provided with a total of 1500 mL extra water consumption and 500 mL 30 min before 3 main meals, for 8 weeks, and the participants were asked not to make any changes in their daily physical activity and diet. Before the study, the BMI values of the participants were calculated, their body fat was calculated by taking the skinfold thickness of the three regions, and their appetite scores before the three main meals were determined. At the end of the study period, it was determined that there was a significant decrease in BMI values, body fat, and appetite scores. In conclusion, it was revealed that an extra 1500 mL/day of water consumption for 8 weeks had a positive effect on body weight and composition [45]. According to the results of another study, a positive correlation was observed between water consumption and total body water and an inverse relationship with body fat mass, especially in men. In conclusion, it seems quite clear that there is a relationship between water consumption and body composition. These findings suggest that a sufficient level of water consumption can improve body composition [7•].

When the effect of water consumption on body water is examined, adequate water consumption may also be protective against the formation of edema. In case of hyperhydration, urinary fluid excretion becomes more important and the body's water storage capacity is limited, and on the contrary, the risk of fluid retention will increase [64]. Arginine vasopressin (AVP) is responsible for the underlying mechanism. Water consumption results in a decrease in AVP. AVP, the main endocrine regulator of renal water excretion, is an antidiuretic [65]. In a study conducted in 20 healthy volunteers with an average age of 42 years, participants recorded all food and water intakes for 2 weeks. In the second week, they increased their water consumption by 716 mL (32%). As a result, it was determined that low fluid intake was associated with higher body fluid volume [66].

Effects of Overhydration

Total body fluid in the body is perfectly regulated under normal conditions, and aquatic toxicity is rare [67, 68]. Water toxicity, which can be seen in some cases such as excessive water ingestion, usually refers to hyponatremia with plasma $[Na+] < 135$ mmol/L [67]. In water intoxication, the intracranial pressure increases with the increase in the amount of intracellular water, and this leads to various symptoms such as confusion and headache [68], and the results can be fatal [67]. Excessive fluid intake may also exacerbate proteinuria [69] and may accelerate the progression of chronic kidney disease [70]. In a case report reported in the past years, it was observed that a 16-year-old Chinese girl drank 20 L/day of water for a while due to facial acne, and a coma developed in a young girl who was taken to the hospital one day because of not being able to wake up from sleep. It was observed that serum electrolyte values returned to normal after 6 months of 1.5 L/day fluid restriction [71].

Conclusion

Water is essential for life and has many essential functions for maintaining body homeostasis. Water consumption, which provides acute changes in human physiology, creates a sympathetic stimulus and at the same time increases the metabolic rate and therefore energy expenditure by inducing thermogenesis. On average, 500 mL water consumption provides an additional 100 kJ increase in energy expenditure. At the same time, the temperature of the consumed water comes to the fore, and it is stated that cold drinking water may be more effective in stimulating thermogenesis.

The increase in fat oxidation by various mechanisms together with the increased water consumption affects body weight. Additionally, consuming water instead of high-energy drinks is an approach to reducing energy intake. Because when individuals consume high-energy drinks, they usually do not go to reduce the energy they take in their meals. A summary of various studies on energy metabolism and body weight management of water consumption is presented in Table 1. In conclusion, if this information is supported by more studies to be done in the future, increasing water consumption may play a role as an adjunctive treatment by increasing energy expenditure in the fight against obesity.

Author Contribution MEÇD collected the literature and prepared the draft. NAT edited the article.

Compliance with Ethical Standards

Conflicts of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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•• Of major importance

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