Open Peer Review on Qeios

"Mealtime Hydration's Impact on Digestion": An Editorial Article

Nooshin Abbasi[1]

1 University of Padua

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

Understanding the impact of mealtime hydration on digestion is important for optimizing nutrition. Water plays various roles in human health, including as a solvent and transport medium. Its influence on digestion and gastric emptying is still not fully understood. Contemporary studies challenge traditional recommendations against consuming beverages with meals, particularly questioning the timing and temperature of water intake. Despite extensive research, clarity on this topic is lacking. Some studies suggest that meal temperature and composition affect gastric emptying, but when matched for calorie content and volume, gastric emptying times may be similar regardless of composition or initial state. Understanding how water temperature, when consumed at mealtimes, alters food temperature and further influences digestion is crucial. Additionally, in cases where calorie content and total volume are not matched, consuming water at mealtime can change the food composition, making it more liquid and facilitating digestion. This editorial article aims to identifies research gaps and suggests avenues for future investigations into optimal hydration at mealtimes, and to guide nutritionists and health professionals in developing strategies for promoting gastric health in their patients.

Keywords: water; mealtime; hydration; temperature; digestion; gastric emptying.

Introduction

The act of drinking water at mealtimes has stirred considerable debate despite its commonality. This editorial delves into the intricate relationship between water intake and digestion.

Sensors within the upper gastrointestinal tract, including mechanoreceptors, chemoreceptors, and thermoreceptors, are crucial for controlling food digestion. When a meal is consumed, it activates pathways sensitive to mechanical pressure and nutrients. The stretching of the stomach activates mechanoreceptors sensitive to stretch and tension, leading to signals sent to the central nervous system. This process also influences vasovagal reflexes, resulting in the relaxation of the proximal stomach, which contributes to feelings of satiety and fullness[1].

While some caution against concurrent food and beverage consumption[2][3], others advocate for specific water intake timings, presenting potential health benefits[4][5]. However, conflicting perspectives abound.

Recent studies shed light on the influence of meal temperature on gastric emptying[6][7], while the composition of food further complicates matters [6][8]. Understanding how hydration at mealtimes impacts digestion is paramount for both individuals with gastrointestinal conditions and those in good health.

Evidence-based guidelines are essential for refining existing recommendations and optimizing nutritional practices. By meticulously analyzing research and unraveling the interactions between hydration, meal variables, and gastric physiology, this editorial article aims to elucidate the necessity for further research on this matter due to the existing gaps in understanding and the prevalence of controversies surrounding it.

Gastric Physiology and Water Intake:

Water, a fundamental molecule in biology, plays various crucial roles in the human body. It acts as a structural component, a solvent for biochemical reactions, and a medium for cellular transport and waste removal. Additionally, it contributes to thermoregulation through its impressive heat capacity, serves as a lubricant and shock absorber, and facilitates molecular bond weakening for ion movement and hydrolysis reactions essential for macronutrient breakdown, including proteins, carbohydrates, and lipids[9]. Despite its significance, the specifics of water intake remain largely unexplored.

The digestive process consists of three main phases: cephalic, gastric, and postprandial. The cephalic phase involves preparatory processes triggered by food anticipation, including salivary amylase secretion. During the gastric phase, the focus is on accommodation, acid secretion, and initial food breakdown. Gastric emptying is regulated by hormonal and neural signals from the duodenum in response to nutrient presence[10].

Different Perspectives:

Opposing viewpoints exist on how hydration at mealtimes affects digestion. Some emphasize potential disruption caused by diluted stomach contents[2][3], while others promote mindful water intake at mealtimes[11][12]. According to Traditional Persian Medicine (TPM), esteemed figures such as Avicenna and Razi postulate that excessive water consumption may weaken the gastrointestinal (GI) tract, heightening the risk of organ diseases. Adherence to their specific drinking guidelines, considering factors such as timing, constitution, and activity levels, is advised for optimal health. Water or water-rich foods are discouraged shortly before or at mealtimes, except for individuals with high metabolic rates and pronounced thirst sensitivity due to a warm constitution[13][14]. However, it's worth noting that the mechanisms behind these advices have not been studied extensively. Avicenna cautions against drinking water during or after intense activities and advise delaying consumption upon waking. Optimal hydration should coincide with genuine thirst. Lukewarm or warm water may harm the GI tract, so prioritize cool water intake without excessive chilling. Sip water slowly for proper GI system preparation and utilization. Extend the interval between meals and water intake for better health[13].

A study explored traditional approaches to manage flatulence as a prevalent GI issue. This study highlighted some dietary modifications, such as avoiding beverage consumption during and directly after meals, and delaying the intake of beverages, vegetables, and fruits by 1-1.5 hours post-meal, to mitigate flatulence[2]. These strategies are also recommended for managing meteorism[3].

In the contemporary literature, concrete evidence regarding the relationship between water intake timing and digestion remains elusive. Studies have examined divergent aspects of hydration at mealtimes. For instance, their investigations focused on how eating and water intake affect satiety and hunger[11][12].

The first study suggested that alternating between food and water intake might increase energy consumption by reducing the development of Sensory-Specific Satiety (SSS)[11]. Longer meal durations allow for increased food intake and more frequent switching between bites and sips. Contrary to common recommendations, drinking water with meals was positively associated with food intake, possibly due to physiological mechanisms and the alleviation of oral thirst sensations. Overall, water intake influences food intake through dynamic sensory exposure and SSS-driven meal termination[11].

The second one showed that while water influenced feelings of satiety and hunger at mealtimes, these effects did not persist afterward. This funding suggested that subjective feelings of satiety and hunger may change independently of calorie intake at mealtime[12].

Temperature Dynamics:

Intriguingly, research has revealed that meal temperature plays a significant role in gastric emptying[6, 7]. In a study, a hot meal at 60°C led to faster gastric emptying compared to warm (37°C) and cold (4°C) meals, both in liquid and solid forms. However, this acceleration seems to be primarily attributed to the thermal effect in the early phase of gastric emptying, as food temperature equilibrates with body temperature within 5-30 minutes post-ingestion. These findings suggest that meal temperature influences gastric emptying, though the exact mechanism warrants further investigation[6].

Additionally, cold temperatures can induce both smooth muscle contraction and the activation of transient receptor potential (TRP) channel receptors, which are part of the mammalian TRP superfamily. Specifically, low temperatures activate TRPM8 and TRPA1, whereas high temperatures activate TRPV1, TRPV2, TRPV3, TRPV4, and TRPM4 receptors[15].

Several scientists suggested that meals at 37°C, regardless of consistency, could induce more profound relaxation of gastric muscles than colder counterparts, delaying initial emptying. This may be explained by potentially thermal stimulating the gastric pacemaker during the phase of gastric accommodation. This stimulation could influence the timing and intensity of gastric contractions[16].

Other studies highlighted the impact of temperature on the regular propagation of gastric peristaltic waves, essential for emptying force[17]. Consequently, there is speculation that a reduction in temperature may decelerate gastric emptying. Another possible mechanism through which meal temperature influences gastric emptying is the thermal stimulation of thermoreceptors in the gastrointestinal tract[18]. In Yuko Mishima et al. 2009 study, gastric emptying notably sped up within 30 minutes after consuming a hot liquid meal. While the hot solid meal test showed a tendency for accelerated emptying, without statistical significance[8].

The distinction between liquid and solid meals[6][8] highlights the complexity of digestive responses, with distinct patterns observed in gastric, pancreatic, and biliary functions.

The emptying process for liquid and solid meals is governed by distinct mechanisms within the stomach, with liquid meal emptying primarily influenced by the proximal stomach and solid meal emptying primarily controlled by the gastric antrum and pylorus[16].

In a crossover investigation, researchers examined the gastric emptying kinetics of various liquid and solid foods with equal volumes. They suggested that when caloric content and total volume are matched, gastric emptying times may be similar regardless of compositional differences or initial state. This finding underscores two principles: firstly, that within a fixed food volume, caloric load is a critical determinant of gastric emptying; and secondly, that the energy content, not volume, may primarily regulate gastric emptying rates[19].

Conclusion:

In conclusion, this study synthesizes historical perspectives with contemporary medical insights regarding water intake and its impact on gastric physiology. Avicenna's caution against excessive water consumption aligns with modern recognition of hyperhydration as a rare but significant condition, particularly in pathological contexts. For healthy individuals, emphasis on food composition over water intake at mealtimes emerges as pivotal in dictating gastric emptying duration. However, caution is advised regarding water consumption during or immediately after meals due to potential exacerbation of discomfort, particularly in the context of flatulence management. Additionally, investigations into the influence of food temperature on gastric emptying dynamics reveal complexities, with hot liquid meals demonstrating significant acceleration compared to solid meals. Importantly, consideration of water temperature at mealtimes, and its impact on food temperature, suggests avoiding cold water and cold drinks due to their potential to delay gastric emptying and hinder digestion. These findings underscore the need for further research to delineate specific guidelines considering individual health variations and the intricate interplay between water consumption, temperature, and gastric physiology. Ultimately, refining existing practices will be crucial in guiding individuals seeking to enhance their digestive well-being.

Statements and Declarations

Competing Interests

The author has no competing interests to declare that are relevant to the content of this article.

Funding

The author did not receive support from any organization for the submitted work.

Author Contributions

The author, N.A., conceived the idea for the article, conducted the literature review, and drafted and critically revised the entire manuscript. The author, N.A., approved the version to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. [^] *Fernando Azpiroz. (2005). Intestinal perception: mechanisms and assessment. Br J Nutr, vol. 93 (S1), S7-S12. doi:10.1079/bjn20041338.*
2. [a, b, c] *Bagher Larijani, Mohammad Medhi Esfahani, Maryam Moghimi, Mohammad Reza Shams Ardakani, et al. (2016). Prevention and Treatment of Flatulence From a Traditional Persian Medicine Perspective. Iran Red Crescent Med J, vol. 18 (4). doi:10.5812/ircmj.23664.*
3. [a, b, c] *(2024). Meteorism. Treasure Island (FL): StatPearls Publishing.*
4. [^] *Florent Vieux, Matthieu Maillot, Colin D. Rehm, Pamela Barrios, et al. (2019). The Timing of Water and Beverage Consumption During the Day Among Children and Adults in the United States: Analyses of NHANES 2011–2016 Data. Nutrients, vol. 11 (11), 2707. doi:10.3390/nu11112707.*
5. [^] *Asma Salari-Moghaddam, Negar Aslani, Parvane Saneei, Ammar Hassanzadeh Keshteli, et al. (2020). Water intake and intra-meal fluid consumption in relation to general and abdominal obesity of Iranian adults. Nutr J, vol. 19 (1). doi:10.1186/s12937-020-00551-x.*
6. [a, b, c, d] *Yuko Mishima, Yuji Amano, Yoshiko Takahashi, Yoshiyuki Mishima, et al. (2009). Gastric emptying of liquid and solid meals at various temperatures. J Gastroenterol, vol. 44 (5), 412-418. doi:10.1007/s00535-009-0022-1.*

7. ^José María Remes-Troche. (2013). "Too Hot" Or "Too Cold": Effects of Meal Temperature on Gastric Function. Dig Dis Sci, vol. 58 (9), 2439-2440. doi:10.1007/s10620-013-2789-4.
8. a, b, c ROBERT S. FISHER, LEON S. MALMUD, PAUL BANDINI, ELIZABETH ROCK. (1982). Gastric Emptying of a Physiologic Mixed Solid-Liquid Meal. Clinical Nuclear Medicine, vol. 7 (5), 215-221. doi:10.1097/00003072-198205000-00005.
9. ^E Jéquier, F Constant. (2009). Water as an essential nutrient: the physiological basis of hydration. Eur J Clin Nutr, vol. 64 (2), 115-123. doi:10.1038/ejcn.2009.111.
10. ^Ricard Farré, Jan Tack. (2013). Food and Symptom Generation in Functional Gastrointestinal Disorders: Physiological Aspects. doi:10.1038/ajg.2013.24.
11. a, b, c, d Paige M. Cunningham, Liane S. Roe, Kathleen L. Keller, Barbara J. Rolls. (2023). Switching between bites of food and sips of water is related to food intake across meals varying in portion size. Appetite, vol. 182 , 106443. doi:10.1016/j.appet.2022.106443.
12. a, b, c Lappalainen R. ; Mennen L. ; Van Weert L. ; Mykkanen H.. (1993) Drinking water with a meal: A simple method of coping with feelings of hunger, satiety and desire to eat. European Journal of Clinical Nutrition, vol. 47 .
13. a, b H A. (1988). Al Qanun Fi Al-Tibb (Persian). Soroush Press, Tehran.
14. ^MZ R. (2000). Al-Havi Fi Al-Tibb (Arabic). Dar Al Kotob Al-islmiyah, vol. 2 .
15. ^Werend Boesmans, Grzegorz Owsianik, Jan Tack, Thomas Voets, et al. (2010). TRP channels in neurogastroenterology: opportunities for therapeutic intervention. British J Pharmacology, vol. 162 (1), 18-37. doi:10.1111/j.1476-5381.2010.01009.x.
16. a, b Howard Minami, Richard W. Mccallum. (1984). The Physiology and Pathophysiology of Gastric Emptying in Humans. Gastroenterology, vol. 86 (6), 1592-1610. doi:10.1016/s0016-5085(84)80178-x.
17. ^KM Sanders. (1996). A case for interstitial cells of Cajal as pacemakers and mediators of neurotransmission in the gastrointestinal tract. Gastroenterology, vol. 111 (2), 492-515. doi:10.1053/gast.1996.v111.pm8690216.
18. ^R. O. Rawson, K. P. Quick. (1972). Localization of intra-abdominal thermoreceptors in the ewe. The Journal of Physiology, vol. 222 (3), 665-677. doi:10.1113/jphysiol.1972.sp009820.
19. ^T. Okabe, H. Terashima, A. Sakamoto. (2017). A comparison of gastric emptying of soluble solid meals and clear fluids matched for volume and energy content: a pilot crossover study. Anaesthesia, vol. 72 (11), 1344-1350. doi:10.1111/anae.14026.