# Beverage Hydration Index

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## Abstract

This communication describes beverage hydration index (BHI) and reviews its utility in clinical practice. BHI is defined as the urine output within 4 h of consuming 1000 ml of still water, relative to the urine output after taking an equal amount of a particular beverage. BHI can be used to objectively assess the hydrating capacities of beverages. This helps plan person-specific beverage advice to suit the preferences and requirements of a particular individual.

**Keywords:** Bladder comfort, fluid balance, glycemic index, hydration gradient, hydration index

## Introduction

The beverage hydration index (BHI) is a relatively recent concept which helps compare the hydration efficacy of various beverages. In this brief communication, we describe the BHI, review evidence related to it, and suggest novel usage for the index.

## Definition

Maughan *et al*.[1] proposed the BHI in 2016, testing the effects of 13 commonly used beverages on urine output and fluid balance. BHI is defined as follows:

$$\text{BHI} = \frac{\text{Urine output at 4 h, after consuming 1000 ml of still water over 30 min}}{\text{Urine output at 4 h, after consuming 1000 ml of beverage over 30 min}}$$

While Maughan RJ *et al.*[1] gave their participants 30 min to consume the respective beverage, modern researchers now prefer a 15-min drinking window.

## Evidence

Maughan *et al*.[1] found that BHI was higher for oral rehydration solution, full-fat milk, and skimmed milk, as compared to water. Carbonated drinks (both sugary and sugar-free), tea (both hot and iced), coffee, lager beer, orange juice, sparking water, and sports drink had a BHI such as that of water. Millard-Stafford *et al*.[2] demonstrated that drink containing both carbohydrates and electrolytes had a higher BHI at 120 min, while a drink containing 2 g dipeptide (alanyl-glutamine) with electrolyte offered a higher BHI at 240 min. Electrolyte content appeared to contribute maximally to hydration.

BHI has been used to assess hydration capacity of various commercially available beverages[3] as well as milk permeate solution, which is an electrolyte-rich, protein-free, and fat-free liquid, with carbohydrate and mineral content such as that of milk, has been shown to have a high BHI.[4]

Clarke *et al*. reported a differential response based on age. Older persons had a higher BHI with 30 mmol/l of 5 amino acid-based beverages, while in younger persons, 60 mmol/l of an 8 amino acid-based hydration beverage had a higher body mass index (BMI).[3] Sodium concentration of the beverage was associated with higher BMI in younger persons as well.

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Sollanek *et al*., on the other hand, demonstrated that sex and body mass do not influence BHI.[5] In a study on BHI and cardiac autonomic functions, Bechke *et al*. showed that an isotonic beverage had not only higher fluid-retaining capacity but led to a relatively higher heart rate.[6]

## Comparison with Glycemic Index

BHI can be considered such as glycemic index (GI) which quantifies the rate of rise of glucose after ingesting a carbohydrate-containing food. While GI uses 50 g glucose or white bread as a comparator, BHI is calculated relative to 1000 ml of still water. While the maximum GI is 100, BHI can be more or less than one. Furthermore, though GI of a food is the incremental area under a 2-h blood glucose response curve, BHI is calculated over 4 h. GI needs a 12-h fast for assessment, but BHI is measured after a standardized ginner, sleep, and breakfast.

## Use and Utility

While changes in body weight, urine osmolality, and serum osmolality have been used to assess hydration status, the BHI represents an easily reproducible, accurate means of evaluating various beverages. This helps on therapeutic decision-making. The BHI allows health-care professionals to suggest appropriate drinks for individuals based on their dietary needs and limitations [Table 1].

These data suggest that BHI can be used to assess and evaluate beverages for use in persons who fast for long periods of time, e.g. during Karva Chauth, Navratri, Ramadan, Jain fasts, and Lent. BHI may also be used to analyze drinks that are consumed by sportspersons, and by people who have been advised limited fluid intake, e.g. those with heart failure, decompensated liver disease, and kidney disease with fluid overload. BHI may prove useful in disease states such as diabetes insipidus, psychogenic water drinking and diabetes mellitus, and drug therapy such as diuretic or sodium-glucose transporter 2 inhibitor usage where urine output is increased.

## Extended Hydration Metrics

Other metrics from diabetology can be used to buttress the concept of BHI. The concept of BHI can be strengthened by creating an extended BHI (eBHI), lasting up to 8–12 h. This will allow evidence-based choice of drinks to be consumed in the prefasting meal. The information will be of benefit to countless millions of people who fast for religious, spiritual, or health reasons.

Hydration gradient can be used to define the relative urine output over 2-h long blocks of time during the 8–12 h that eBHI is measured. This information may help persons who wish to predict their physiological response of micturition and can create a person-centered concept of bladder comfort. Bladder comfort, i.e. the lack of pressure to pass urine, is influenced by multiple reasons, but the type of beverage consumed may be a contributory factor as well. This too should be enquired for which measuring BHI. Just as satiety is an important aspect of weight homeostasis and management, fluid satiety, or quenching is equally important for hydration homeostasis. The degree of thirst quenching can be measured, along with BHI, to add a subjective or person-centric viewpoint.

A commonly used glycemic metric is time in range. A similar index can be created to assess the amount of time that urine output, after consuming a particular beverage, remains within 10% or 15% of the urine output produced by drinking 1000 ml of still water.

## Limitations

Most BHI studies have evaluated only limited type of beverages, mainly those being consumed in Western countries. This fact hinders its generalizability to the global context in the mean of cultural and dietary habits. In India, the most utilized beverages are tea, lassi (buttermilk), and coconut water. Furthermore, it needs further research to find out if BHI could be applicable in populations with unique obligatory dietary practices such as lactose intolerance or gluten intolerance.

## Informed Beverage Choices

In the current context, when regulators ask for health star ratings (front-of-pack labeling) on packaged food,[7] it is prudent to share BHI for packaged beverages, as well. These policy changes will have positive overall impact on public health with promotion of healthy hydration habits. In developing countries, where access to safe drinking water remains a challenge,[8] BHI could play a crucial role in promoting hydration and preventing dehydration-related illnesses.

## Conclusion

The concept of BHI is a robust one. It should be studied not only by nutritionists but also by endocrinologists, nephrologists, metabolic physicians, and sports physicians to maximize its utility. As research and experience grow, newer

**Table 1: Utility of beverage hydration index**

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|---|
| Comparison of various kitchen-based and commercial drinks |
| Choice of drinks for persons who need sustained hydration, e.g. |
| Sportspersons in endurance prolonged sports |
| Persons planning to fast for prolonged periods |
| Diseases where restriction of fluid intake is advised, e.g., renal, hepatic, and cardiac illness |
| Diseases where urine output is excessive, e.g., diabetes insipidus, psychogenic water-drinking, diabetes mellitus, diuretic therapy, and SGLT2i therapy |
| Situations where excessive urine output may be a challenge, e.g., lack of toilet facility |
| Diseases where sustained and stable energy release is needed, e.g., diabetes mellitus |

SGLT2i: Sodium-glucose transporter 2 inhibitor

indices such as eBHI may develop and increase the usefulness of these concepts.

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## Conflicts of interest

There are no conflicts of interest.

## References

1. Maughan RJ, Watson P, Cordery PA, Walsh NP, Oliver SJ, Dolci A, *et al*. A randomized trial to assess the potential of different beverages to affect hydration status: Development of a beverage hydration index. Am J Clin Nutr 2016;103:717-23.
2. Millard-Stafford M, Snow TK, Jones ML, Suh H. The beverage hydration index: Influence of electrolytes, carbohydrate and protein. Nutrients 2021;13:2933.
3. Clarke MM, Stanhewicz AE, Wolf ST, Cheuvront SN, Kenefick RW, Kenney WL. A randomized trial to assess beverage hydration index in healthy older adults. Am J Clin Nutr 2019;109:1640-7.
4. Berry CW, Wolf ST, Murray B, Kenney WL. Hydration efficacy of a milk permeate-based oral hydration solution. Nutrients 2020;12:1502.
5. Sollanek KJ, Tsurumoto M, Vidyasagar S, Kenefick RW, Cheuvront SN. Neither body mass nor sex influences beverage hydration index outcomes during randomized trial when comparing 3 commercial beverages. Am J Clin Nutr 2018;107:544-9.
6. Bechke EE, Zaplatosch ME, Choi JY, Adams WM. Utility of an isotonic beverage on hydration status and cardiovascular alterations. Nutrients 2022;14:1286.
7. Food Safety and Standards Authority of India. Minutes of the Stakeholders' Meeting on Front of Pack Labelling Held on 15th February 2022. New Delhi: FSSAI; c2024. Available from: https://www.fssai.gov.in/upload/advisories/2022/02/6214c8ca94fedMinutes_FOPL_22_02_2022.pdf. [Last accessed on 2024 Apr 25].
8. Misra P, Paunikar VM. Healthy drinking water as a necessity in developing countries like India: A narrative review. Cureus 2023;15:e47247.