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# What Characterizes Fluid Intake Patterns across the World?

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**Keywords**
Cluster analysis · Drinking patterns · Children · Beverages intake · Hydration

**Abstract**
***Introduction:*** Total fluid intake and the type of fluids consumed have been reported by many studies [1–3] and have shown that while an individual may be drinking sufficiently, in terms of volume, to meet or exceed recommendations on fluid intake, there may be a wide variety of combinations of fluids within that total volume [4–6]. Moreover, considering only volume and fluid types may limit the interpretation of the data [7]. In a novel approach, we propose to analyze and understand fluid intake patterns as opposed to only fluid volume or types. The primary aim of this study was to identify patterns of fluid intake in children and adolescents from 6 countries: Argentina, Brazil, Mexico, Uruguay, China, and Indonesia. The secondary aim was to characterize those fluid intake patterns. ***Methods:*** A validated 7-day fluid specific record (Liq.In7 record) [8] was used to collect primary data on fluid intake amongst children and adolescents (10–17 years; $N = 1{,}781$). To identify relatively distinct clusters of subjects based on 8 fluid types (water, milk and its derivatives, hot beverages, sugar-sweetened beverages [SSB], 100% fruit juices, artificial/nonnutritive sweetened beverages, alcoholic beverages, and other beverages), a cluster analysis (partitioning around k-medoids algorithm) was used. Clusters were then characterized according to their socio-demographic and lifestyle indicators. ***Results:*** The 6 clusters identified (Fig. 1) were low drinkers – SSB ($n = 523$), low drinkers – water and milk ($n = 615$), medium mixed drinkers ($n = 914$), high drinkers – SSB ($n = 513$), high drinkers – water ($n = 352$), and very high drinkers – water ($n = 264$). Country of residence was the dominant characteristic, followed by socioeconomic level, in all 6 patterns. ***Conclusion:*** Fluid intake patterns among children are primarily driven by water and SSB. In addition to country, socio-demographic and lifestyle factors determined the characteristics of each cluster. Therefore, interventions aiming to encourage healthier fluid intake behavior need to target and be tailored to a particular subpopulation.



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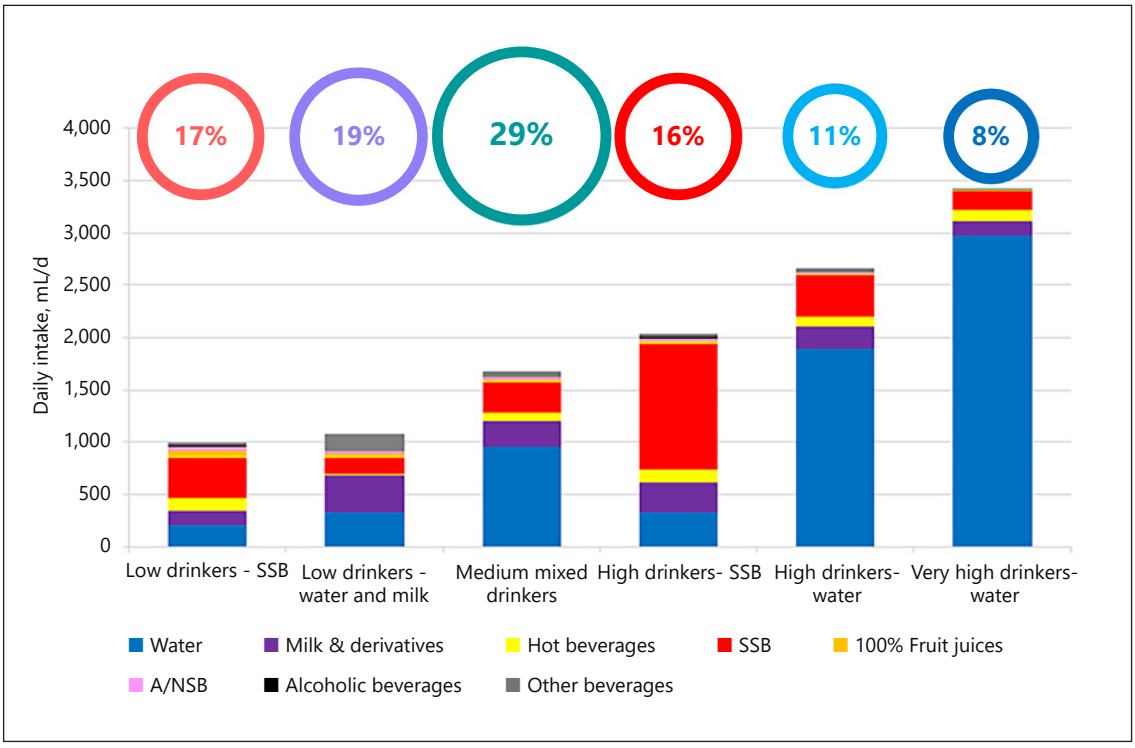


**Fig. 1.** Mean daily intake of different fluid types (mL/day) of each cluster among children and adolescents. SSB, sugar-sweetened beverages.


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## Statement of Ethics

Study approval statement: The protocol of the surveys was reviewed and approved by the Institutional Review Board, Office of Research Compliance of the University of Arkansas (IRB Protocol # 14-12-376). Consent to participate statement: All the participants gave their written informed consent prior the inclusion in the study. All data were recorded and analyzed anonymously.

## Conflict of Interest Statement

C.M. and J.B. are full-time employees of Danone Research. J.G. is a member of the Scientific Committee of Hydration for Health and received consultancy fees from Danone Research. J.S.-S. partially supported by ICREA under the ICREA Academia programme. S.A.K., L.M., and H.M. have received research grants from Danone Research.


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## Data Availability Statement

The datasets used for the purpose of this analysis are available from the corresponding author upon reasonable request.

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