Options for measuring fluid-intake in the daily life

Guillaume Chevance

Tools and Technologies for Drinking Water Quality Assessment
Advancing the Science for Drinking Water Chemical Exposure Assessment and Health Research
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Within-person “day-to-day” variance is high
(one assessment day isn’t sufficient)

https://doi.org/10.1093/tbm/ibaa026

“Automatic” behaviors are subject to recall bias
(it’s difficult to self-report fluid-intake)

https://doi.org/10.1159/000446197
CLASSIC ISSUES WHEN MEASURING BEHAVIORS

Within-person “day-to-day” variance is high
(one assessment day isn’t sufficient)

“Automatic” behaviors are subject to recall bias
(it’s difficult to self-report fluid-intake)

Different methods - both self-reported and more objective ones - have to be combined
Self-reported
- Paper and pencil
- Smartphone-based

“Objective” measures
- Wearables
- Smart containers
**Self-reported**
- Paper and pencil
- Smartphone-based

**“Objective” measures**
- Wearables
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- Most commonly used method in epidemiological studies / part of 24 hour-food recalls
  [https://doi.org/10.1159/000446197](https://doi.org/10.1159/000446197)

- Significant under-estimation compared to fluid-specific 7 days record
  [https://doi.org/10.1007/s00394-015-0945-7](https://doi.org/10.1007/s00394-015-0945-7)

- App-based 7 days records capture higher intake and seems to be the preferred option compared to paper-based ones
  [https://doi.org/10.1007/s00394-015-0954-6](https://doi.org/10.1007/s00394-015-0954-6)
BIG PICTURE OF THE DIFFERENT OPTIONS

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Outcome = quantity
**Self-reported**
- Paper and pencil
- Smartphone-based

**“Objective” measures**
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**Figure 1.** Number of articles reviewed per year.

![Number of Articles Cited per Year](https://doi.org/10.3390/nu13062092)
WEARABLES

Activity monitors
smartwatches

Smart textiles
WEARABLES

Activity monitors
smartwatches

Smart textiles

Towards a generalizable method for detecting fluid intake with wrist-mounted sensors and adaptive segmentation

Authors: Keum San Chun, Ashley B. Sanders, Rebecca Adami, Necole Streeper, David E. Conroy

IUI '19: Proceedings of the 24th International Conference on Intelligent User Interfaces • March 2019 • Pages 80-85 • https://doi.org/10.1145/3301275.3302315
WEARABLES

Activity monitors
smartwatches

Smart textiles

90% accuracy in detecting drinking episodes

Pro = passive measure / only required to wear a smartwatch
Cons = works for only one wrist and not for specific movements (straws)
Activity monitors smarter watches

Smart textiles

Outcome = number of intakes

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Figure 4. Schematic diagram of various sensor layouts for each smart container category, namely (a) inertial [120–124], (b) load and pressure [125], (c) capacitive [126], (d) conductive [127], (e) Wi-Fi [128], (f) vibration [129], (g) acoustic [130], (h) and other sensor [131].

Figure 5. Images of analyzed commercial bottles: (a) HidrateSpark 3 [153], (b) Hidrate Spark Steel [154], (c) H2O Pal [132], (d) Thermos Smart Lid [155], (e) Ozmo Active [156], (f) DrinkUp [158], (g) HydraCoach [159], and (h) Droplet Tumbler [160].
Monitoring fluid intake by commercially available smart water bottles

Rachel Cohen\textsuperscript{1,2,3}, Geoff Fernie\textsuperscript{1,3} & Atena Roshan Fekri\textsuperscript{1,3}

Fluid intake is important to prevent dehydration and reduce recurrent kidney stones. There has been a trend in recent years to develop tools to monitor fluid intake using “smart” products such as smart bottles. Several commercial smart bottles are available, mainly targeting health-conscious adults. To the best of our knowledge, these bottles have not been validated in the literature. This study compares four commercially available smart bottles in terms of both performance and functionality.

Figure 4. Schematic diagram of various sensor layouts for each smart container category, namely (a) inertial\textsuperscript{120–124}, (b) load and pressure\textsuperscript{125}, (c) capacitive\textsuperscript{126}, (d) conductive\textsuperscript{127}, (e) Wi-Fi\textsuperscript{128}, (f) vibration\textsuperscript{129}, (g) acoustic\textsuperscript{130}, (h) and other level sensor\textsuperscript{131}.

Figure 5. Images of analyzed commercial bottles: (a) HidrateSpark 3 [133], (b) Hidrate Spark Steel [134], (c) H20Pal [132], (d) Thermos Smart Lid [135], (e) Ozo Active [136], (f) DrinkUp [138], (g) HydraCoach [139], and (h) Droplet Tumbler [140].
Price ranged between 30 and 100 USD

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Cons = do not capture specific drinking episodes (coffee/tea mug)

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SMART CONTAINERS
Outcome = number of intakes AND volume

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Just-in-time adaptive intervention to promote fluid consumption in patients with kidney stones

David E Conroy ¹, Ashley B West ¹, Deborah Brunke-Rease ¹, Edison Thomaz ², Nicolle M Streeper ³
Just-in-time adaptive intervention to promote fluid consumption in patients with kidney stones

David E Conroy, Ashley B West, Deborah Brunke-Reese, Edison Thomaz, Nicolle M Streeper

Use the whole data flow for sending automatic reminders (notifications)
Just-in-time adaptive intervention to promote fluid consumption in patients with kidney stones

David E Conroy ¹, Ashley B West ¹, Deborah Brunke-Reese ¹, Edison Thomaz ², Necole M Streeper ³

Activity monitor + Smartphone App + Connected bottle

Retention rate good at 3-month
- All assessment methods come with pros and cons
- Combination of methods can be an option
- Outcomes differ from one method to another (intakes versus volume)
- Accuracy of new technologies looks acceptable (high false positive rate for wearables)
- For self-reported methods, implementation via smartphone and over several days should be preferred