

# ACCELEROMETERS IN THE CONTEXT OF INTAKE-BALANCE ASSESSMENTS

FINDINGS, STRATEGIES, AND RESOURCES

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## WHAT'S AHEAD

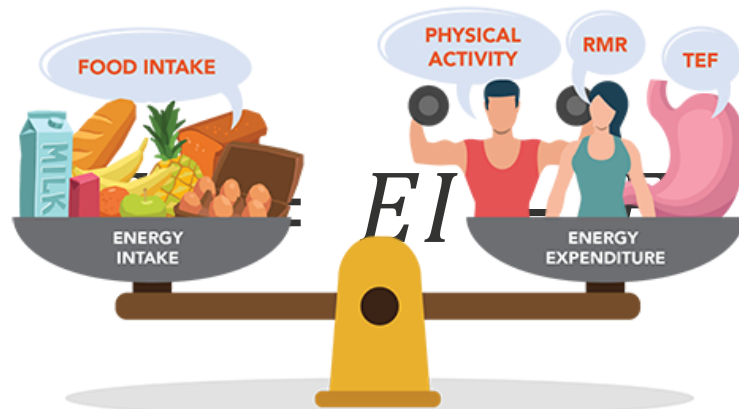
- Overview of the intake-balance method
- Intro to accelerometer-based intake-balance methods
  - Validation methods
  - Prior findings
- Strategies and resources for implementing accelerometer-based intake-balance methods



## OVERVIEW OF THE INTAKE-BALANCE METHOD

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## WHAT IS THE INTAKE-BALANCE METHOD?



activehealth.sg

## WHAT IS THE INTAKE-BALANCE METHOD?

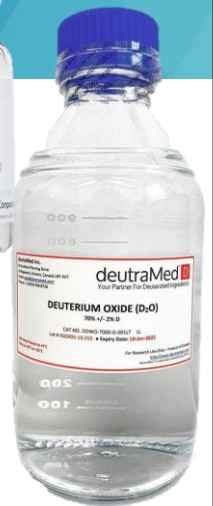
$$EI = \Delta ES + EE$$



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## **INTRO TO ACCELEROMETER-BASED INTAKE-BALANCE ASSESSMENTS**

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## WEARABLES FOR INTAKE-BALANCE

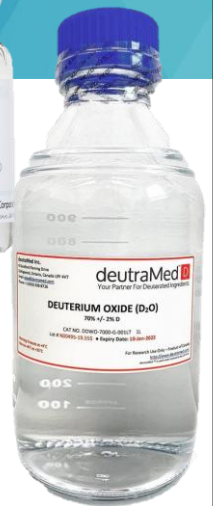
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## WEARABLES FOR INTAKE-BALANCE

$$EI = \Delta ES + EE$$



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## ACCELEROMETRY FOR INTAKE-BALANCE

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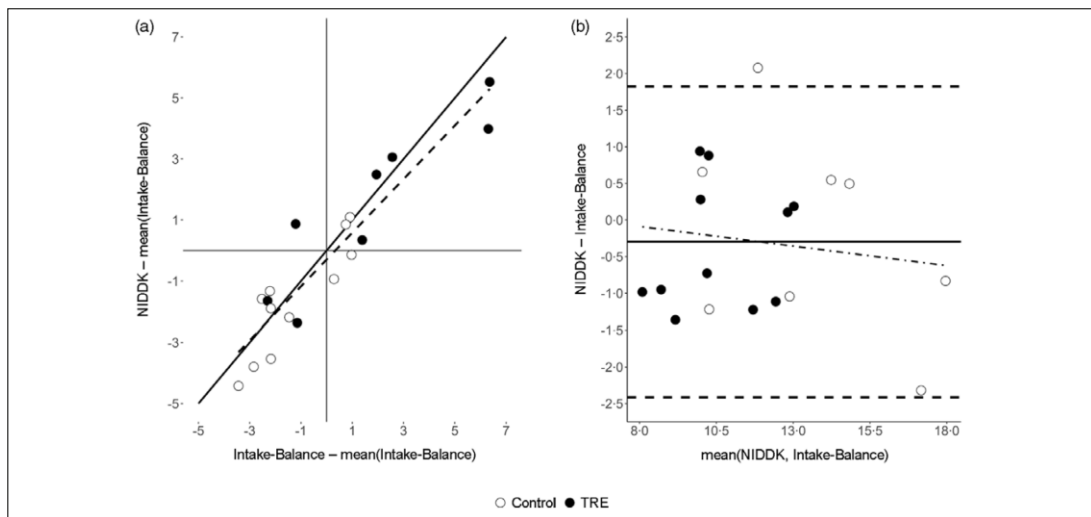
### Predicting energy intake with an accelerometer-based intake-balance method

Paul R. Hibbing<sup>1\*</sup>, Robin P. Shook<sup>1,2</sup>, Satchidananda Panda<sup>3</sup>, Emily N. C. Manoogian<sup>3</sup>, Douglas G. Mashek<sup>4</sup> and Lisa S. Chow<sup>4</sup>

DOI: [10.1017/S0007114522003312](https://doi.org/10.1017/S0007114522003312)



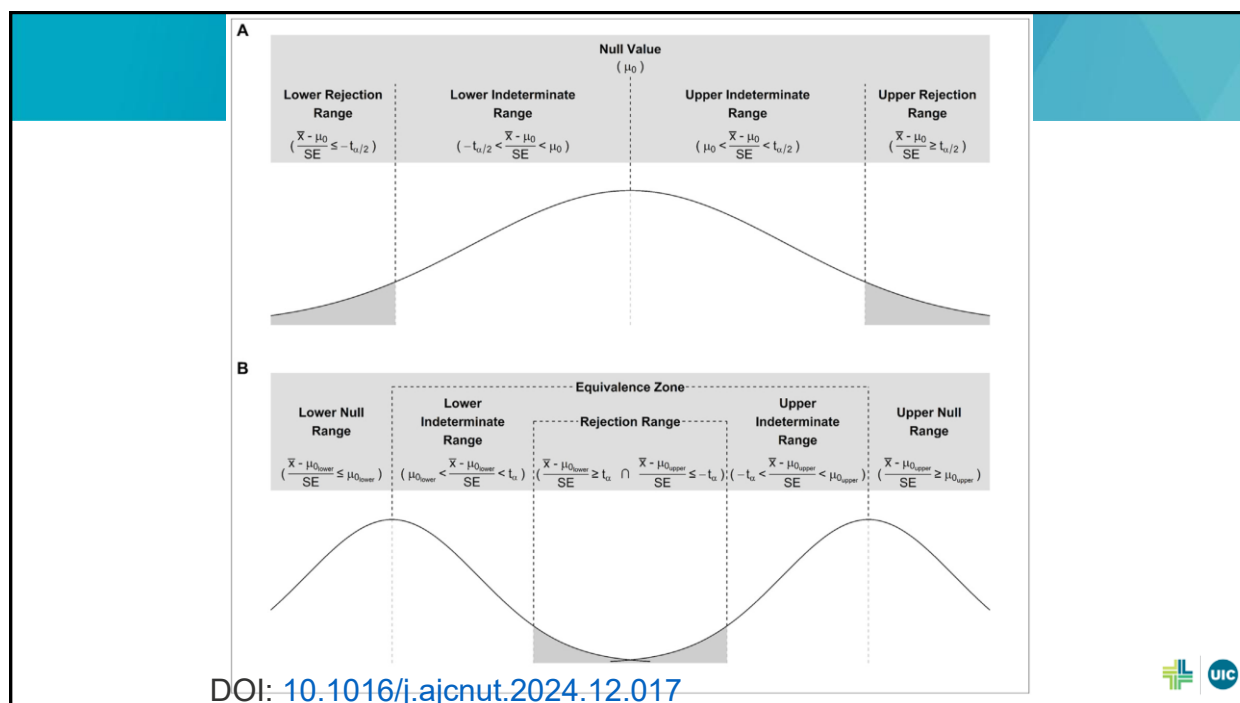
## ACCELEROMETRY FOR INTAKE-BALANCE

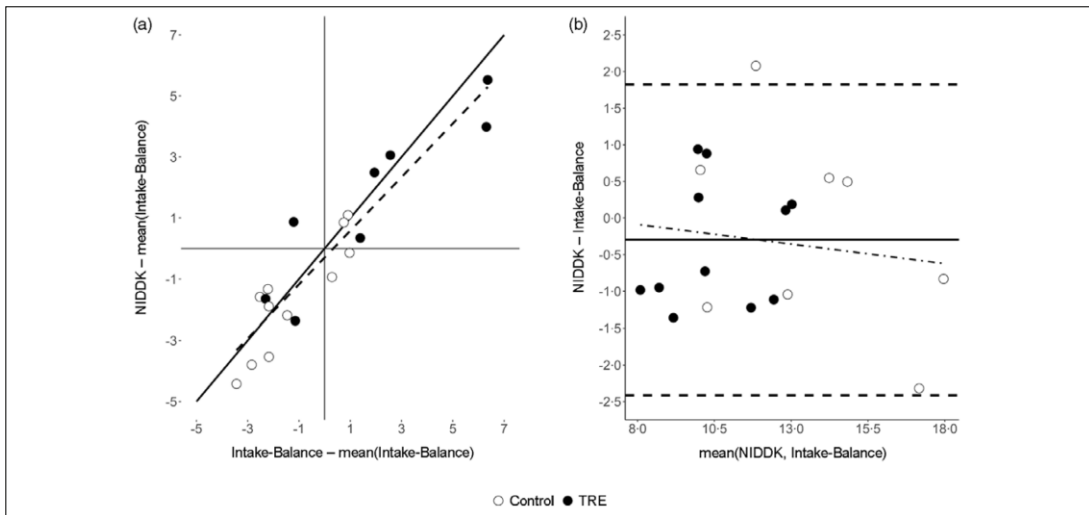


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Hibbing et al. *Int J Behav Nutr Phys Act* (2023) 20:115  
<https://doi.org/10.1186/s12966-023-01515-0>


International Journal of Behavioral  
Nutrition and Physical Activity


**METHODOLOGY** **Open Access**

**Criterion validity of wrist  
accelerometry for assessing energy intake  
via the intake-balance technique**

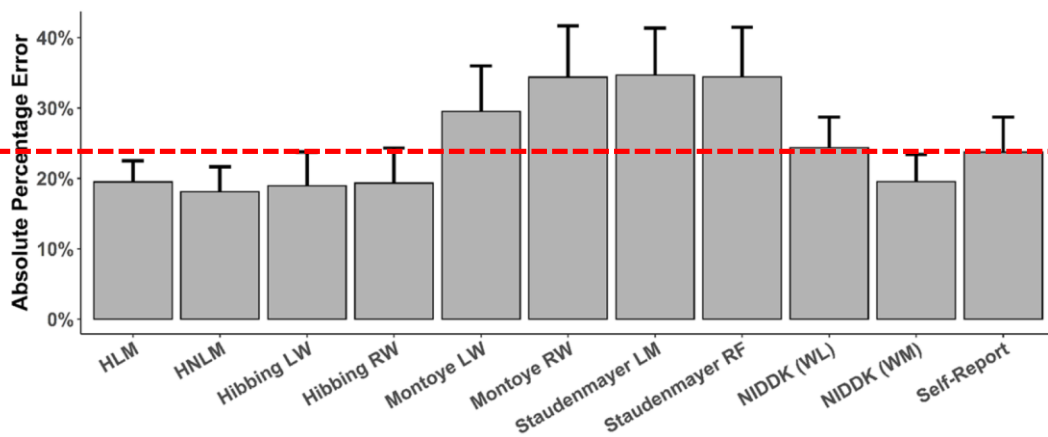
Paul R. Hibbing<sup>1,2\*</sup> , Gregory J. Welk<sup>3</sup>, Daniel Ries<sup>4</sup>, Hung-Wen Yeh<sup>5,6</sup> and Robin P. Shook<sup>2,6</sup>

DOI: [10.1186/s12966-023-01515-0](https://doi.org/10.1186/s12966-023-01515-0)





## ACCELEROMETRY FOR INTAKE-BALANCE



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## BIGGER PICTURE

- Accelerometer methods can be improved over time
- Accelerometers can measure and record continuously





# STRATEGIES & RESOURCES

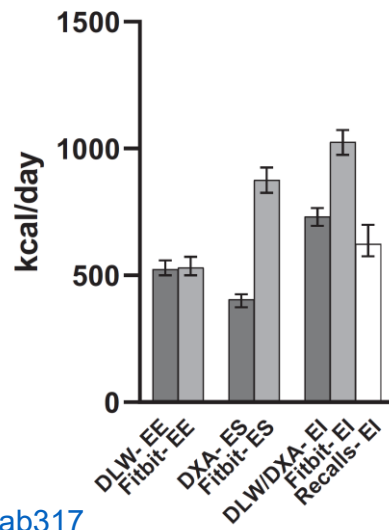
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## CONSUMER-GRADE TECHNOLOGY

$$EI = \Delta ES + EE$$



## CONSUMER-GRADE TECHNOLOGY



DOI: [10.1093/jn/nxab317](https://doi.org/10.1093/jn/nxab317)



## RESEARCH-GRADE (ACCELEROMETER) TECHNOLOGY: ROADMAP

- (Choose a device and protocol; collect data)
- Pick and apply an EE algorithm
  - <https://sites.google.com/view/accelerometerrepository>
- Account for non-wear time (and sleep?)
- Determine final EE
- Then proceed to ES data and calculation of EI



## TWO VIGNETTES

- [paulhibbing.com/TREaccel](http://paulhibbing.com/TREaccel) (basic)
- [paulhibbing.com/IntakeBalance](http://paulhibbing.com/IntakeBalance) (enhanced)



## APPLYING EE ALGORITHMS

- Read files into R
  - Helpful packages: [read.gt3x](#), [GENEAread](#), [GGIRread](#), [AGread](#)
- Pre-process data (format it according to algorithm's demands), apply the algorithm, and (if applicable) post-process the data, e.g., by averaging estimates every minute
  - For a number of algorithms, this can be done in one big step using the [accelEE](#) package



## ACCOUNTING FOR NON-WEAR

- Run a non-wear detection algorithm
  - Useful packages are [PhysicalActivity](#) (Choi algorithm) and [GGIR](#)
  - [Ahmadi et al.](#) have also tested some useful algorithms for raw acceleration
- Overlay non-wear data on EE data, and exclude EE estimates from non-wear periods
- If desired, use imputation to compensate for the lost data (e.g., by assigning resting EE to non-wear periods as a conservative measure)
  - The [PAutilities](#) package has functions to estimate basal/resting EE using, e.g., Harris-Benedict and Schofield equations, etc.



## DETERMINE FINAL EE

Date	total_minutes	total_hildebrand_linear	total_is_Sleep	total_is_NonWear
9/18/2019	1440	2.536927	828	490
9/19/2019	1440	2.512302	816	500





## CALCULATING EI

PID	fm_start	fm_end	ffm_start	ffm_end	ee	n_days
001	50.5	50.7	75.1	74.9	1950	14
002	70.2	70.0	90.3	90.3	2473	14

Now let's calculate EI:

```
## Generate the result
df_result <- IntakeBalance::IntakeBalance(

  ## These arguments still refer to the same information outlined previously,
  ## but now we have added a layer of abstraction to reference the names of
  ## columns where that information is stored, rather than providing the
  ## values themselves
  fm_start = "fm_start",
  fm_end = "fm_end",
  ffm_start = "ffm_start",
  ffm_end = "ffm_end",
  ee_per_day = "ee",
  n_days = "n_days",

  ## The trick is to pass in a data frame via this extra argument. That's how R
  ## knows to interpret the other variables as column names rather than raw values
  df = info

)

## Show the result
knitr::kable(df_result)
```

PID	fm_start	fm_end	ffm_start	ffm_end	ee	n_days	delta_ES	EI
001	50.5	50.7	75.1	74.9	1950	14	121.1429	2071.143
002	70.2	70.0	90.3	90.3	2473	14	-135.7143	2337.286

## ZOOMING BACK OUT

- (Choose a device and protocol; collect data)
- Pick and apply an EE algorithm
  - <https://sites.google.com/view/accelerometerrepository>
- Account for non-wear time
- Determine final EE
- Then proceed to ES data and calculation of EI



## CONCLUSION

- Accelerometer-based intake-balance methods are one of several ways to assess EI, and suitability may vary by study
- Limitations apply
- Teamwork advised
- Lots of questions still to be answered!



THANK YOU

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