

ACCELEROMETERS IN THE CONTEXT OF INTAKE-BALANCE ASSESSMENTS

FINDINGS, STRATEGIES, AND RESOURCES

Paul R. Hibbing, PhD
University of Illinois Chicago



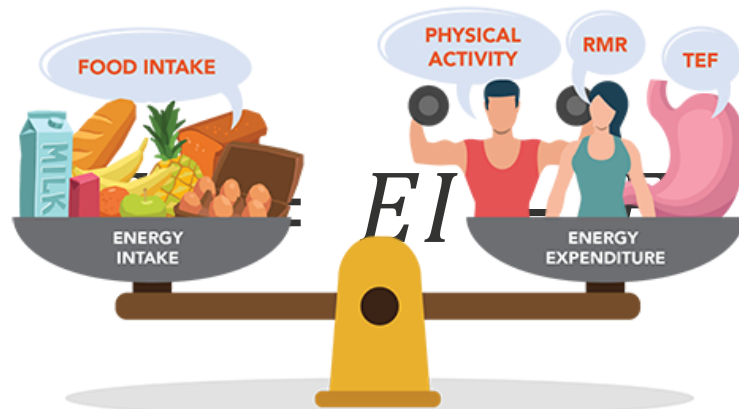
WHAT'S AHEAD

- 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

WHAT IS THE INTAKE-BALANCE METHOD?



activehealth.sg

WHAT IS THE INTAKE-BALANCE METHOD?

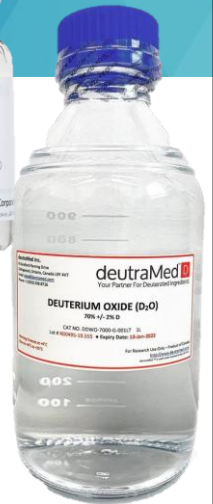
$$EI = \Delta ES + EE$$



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INTRO TO ACCELEROMETER-BASED INTAKE-BALANCE ASSESSMENTS

WEARABLES FOR INTAKE-BALANCE

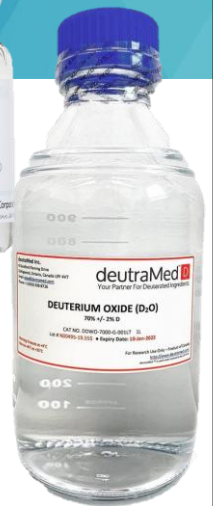
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WEARABLES FOR INTAKE-BALANCE

$$EI = \Delta ES + EE$$



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ACCELEROMETRY FOR INTAKE-BALANCE

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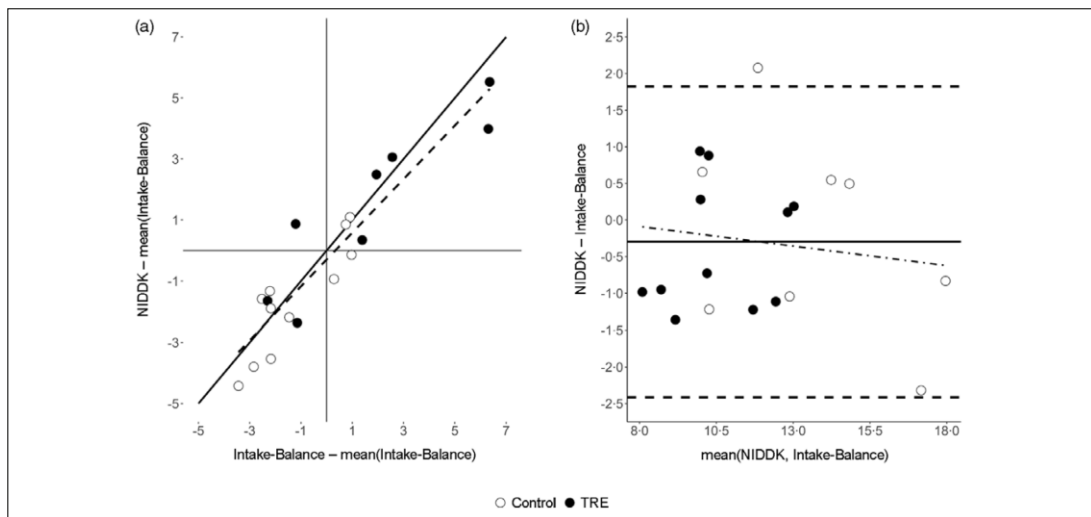
Predicting energy intake with an accelerometer-based intake-balance method

Paul R. Hibbing^{1*}, Robin P. Shook^{1,2}, Satchidananda Panda³, Emily N. C. Manoogian³, Douglas G. Mashek⁴ and Lisa S. Chow⁴

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



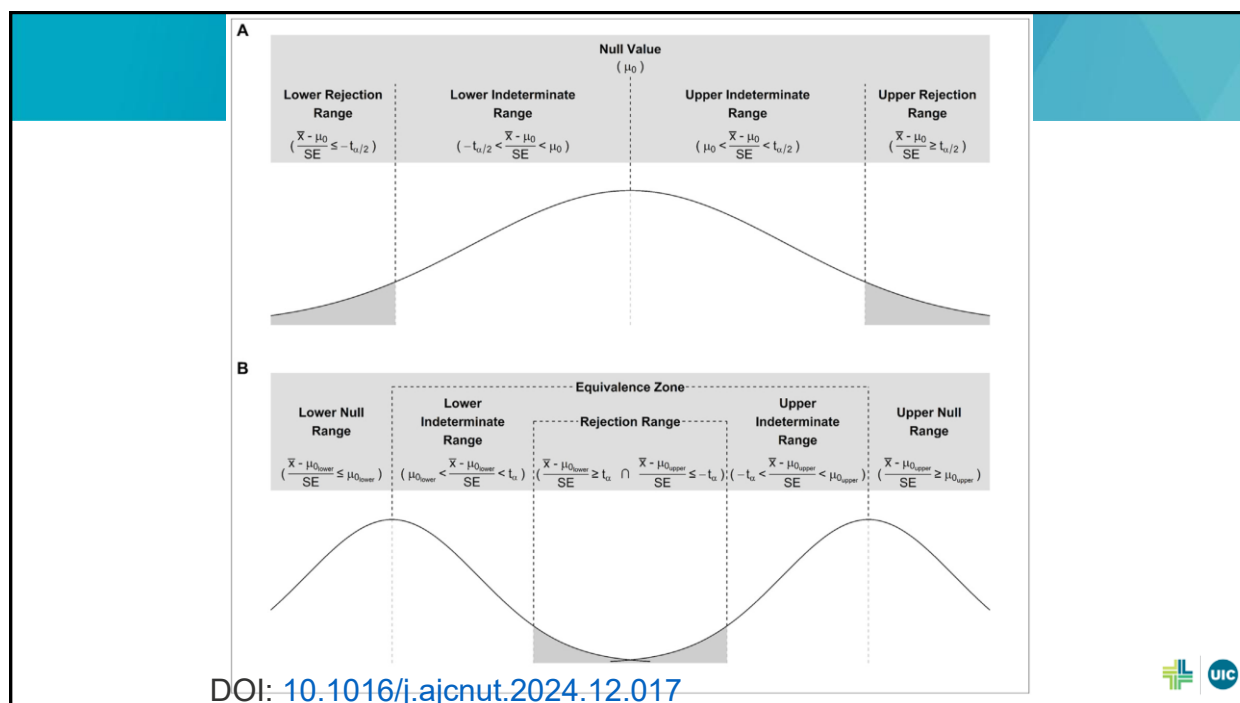
ACCELEROMETRY FOR INTAKE-BALANCE

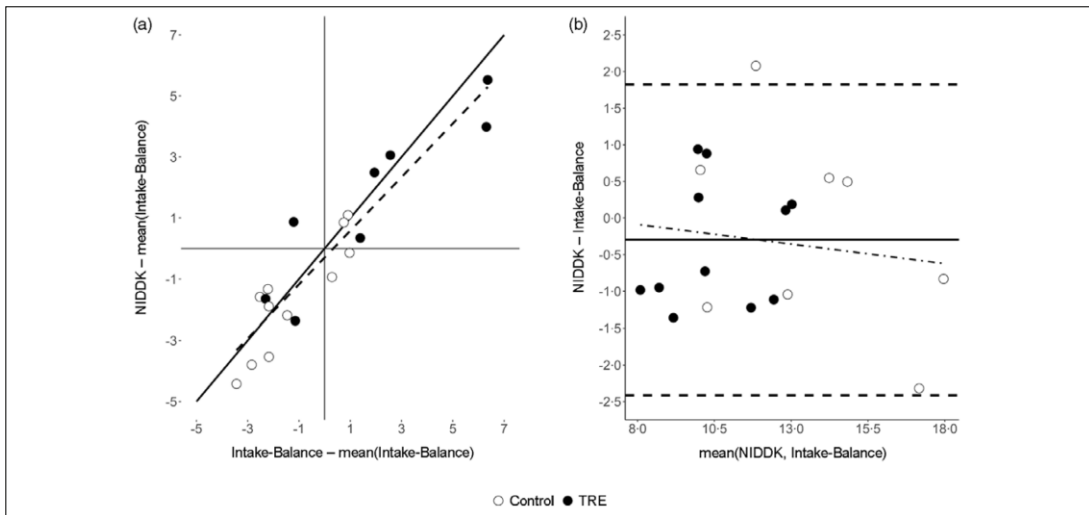


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Hibbing et al. *Int J Behav Nutr Phys Act* (2023) 20:115
<https://doi.org/10.1186/s12966-023-01515-0>


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METHODOLOGY **Open Access**

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

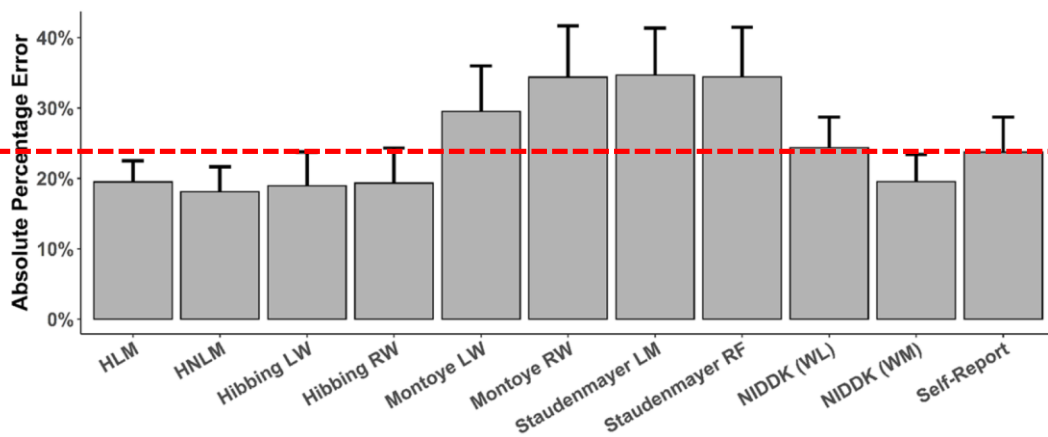
Paul R. Hibbing^{1,2*} , Gregory J. Welk³, Daniel Ries⁴, Hung-Wen Yeh^{5,6} and Robin P. Shook^{2,6}

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



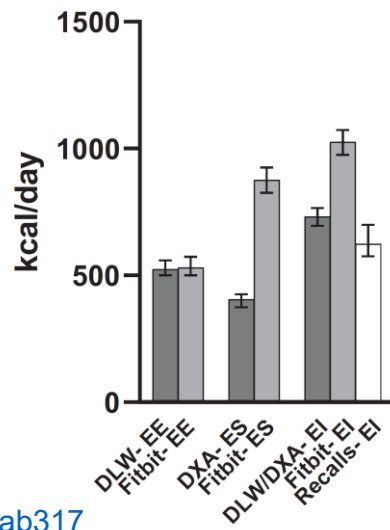
STRATEGIES & RESOURCES

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 (basic)
- 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

