

Introduction

Many children with developmental disabilities (DD) have challenges with diet and energy balance. Energy balance refers to the relationship between energy intake from the diet and energy expenditure, and in turn, its influence on weight status. Energy intake in excess of energy expenditure leads to weight gain, while inadequate energy intake in relation to energy expenditure causes failure to thrive. Individuals with DD can have higher or lower energy expenditure or intake compared to children of similar age and sex with typical development (TD).

When developing nutritional care plans for children with DD, Registered Dietitian Nutritionists (RDNs) look to authoritative guidance from the Academy of Nutrition and Dietetics to estimate energy requirements and achieve appropriate energy balance. The “Pocket Guide for Children with Special Health Care Needs” is published by the Academy of Nutrition and Dietetics, and serves as a reference for RDNs when determining nutritional needs of children with medical issues including DD.

As research continues to reveal new information, it is imperative that the Pocket Guide for CSHCN is periodically updated. The Pediatric Nutrition Practice Group (PNPG) Publications Committee, which is composed of individuals in the Academy of Nutrition and Dietetics with pediatric nutrition expertise, oversees the identification of editors for the new editions of Academy publications. PNPG Publications Committee members also serve as reviewers of new and revised chapters prior to publications. The purpose of this project was to assist with the peer review of a chapter within the CSHCN Pocket Guide related to energy balance in children with DD.

Aims

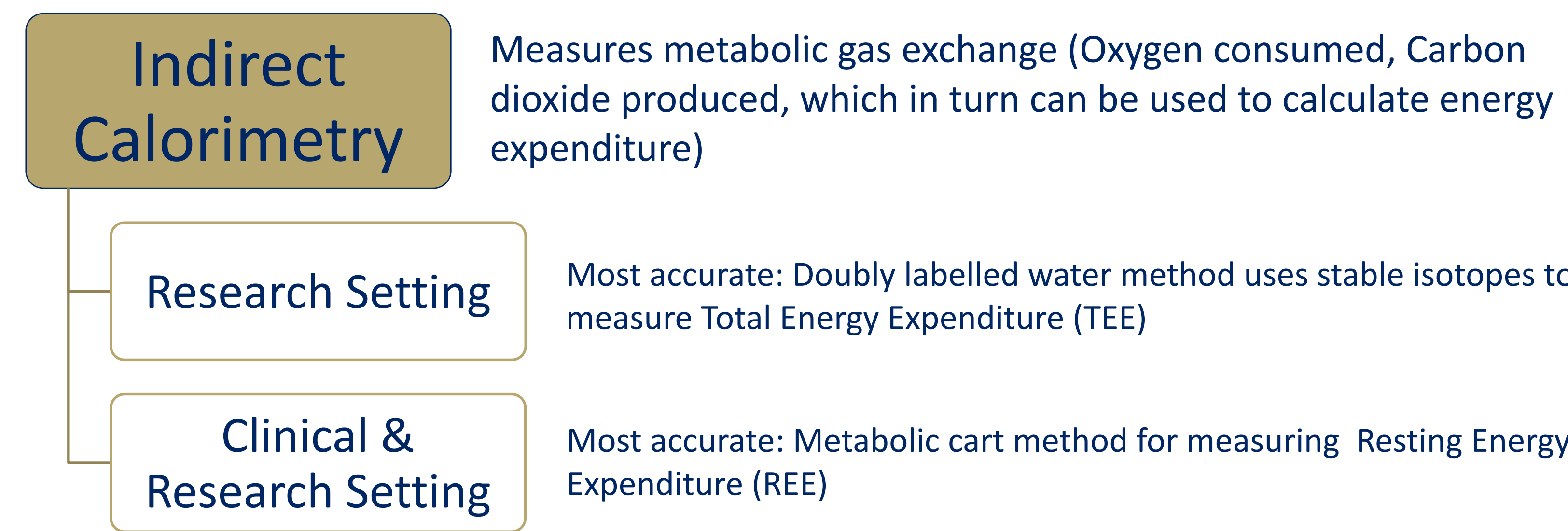
- To ensure that RDNs utilizing the “Pocket Guide for Children with Special Health Care Needs” have the most accurate and current evidence-based recommendations and equations for estimating energy requirements and helping children with DD achieve energy balance.
- Review *Nutrition and Diet* chapter of the “Pocket Guide for Children with Special Health Care Needs” evidence-based recommendations and up to date references for estimating energy requirements of children with special healthcare needs, including DD such as:
 - Down Syndrome
 - Spina Bifida
 - Prader Willi

Methods

- The text and references cited in the *Diet and Nutrition* chapter of the “Pocket Guide for Children with Special Health Care Needs” were reviewed against the literature and the Academy of Nutrition and Dietetics’ Pediatric Nutrition Care Manual [PNCM].
- Review chapter, search literature and denote suggested edits, text additions, and new references for *Diet and Nutrition* chapter of the “Pocket Guide for Children with Special Health Care Needs” with PNPG Publications Committee Chair J. Trabulsi (who is also a member of the Board of Editors for the Pediatric Nutrition Care Manual [PNCM]).
- Special attention and significant edits were made to the energy balance/energy expenditure section of the chapter to educate the reader on the origins and accuracy of equations specific for children with DD versus equations for children with TD.

Results: Measurement of Energy Expenditure

Figure 1: Clarified Methods for Estimating Energy Expenditure



Results: Dietary Reference Intake (DRI) Equations

Table 1. DRI for Estimated Energy Requirements (EER) and Total Energy Expenditure (TEE) – Boys¹

Age (years)	Equation
3-8	$EER = 88.5 - 61.9 \times \text{Age [y]} + PA \times (26.7 \times \text{Wt} + 903 \times \text{Ht}) + 20$
9-18	$EER = 88.5 - 61.9 \times \text{Age [y]} + PA \times (26.7 \times \text{Wt} + 903 \times \text{Ht}) + 25$
3-18 *overweight weight maintenance	$TEE = 114 - 50.9 \times \text{Age [y]} + PA \times (19.5 \times \text{Wt} + 1161.4 \times \text{Ht})$

Abbreviations: EER, Estimated Energy Requirement (kcal/d); Ht, height (meters); PA, physical activity coefficient; TEE, Total Energy Expenditure (kcal/d); Wt, weight (kg).

Table 2. DRI for Estimated Energy Requirements (EER) and Total Energy Expenditure (TEE) – Girls¹

Age (years)	Equation
3-8	$EER = 88.5 - 61.9 \times \text{Age [y]} + PA \times (26.7 \times \text{Wt} + 903 \times \text{Ht}) + 20$
9-18	$EER = 88.5 - 61.9 \times \text{Age [y]} + PA \times (26.7 \times \text{Wt} + 903 \times \text{Ht}) + 25$
3-18 *overweight weight maintenance	$TEE = 114 - 50.9 \times \text{Age [y]} + PA \times (19.5 \times \text{Wt} + 1161.4 \times \text{Ht})$

Abbreviations: EER, Estimated Energy Requirement (kcal/d); Ht, height (meters); PA, physical activity coefficient; TEE, Total Energy Expenditure (kcal/d); Wt, weight (kg).

Table 3. Equations for Estimating Resting Energy Expenditure (REE)

Equation	Age, y	REE for Males	REE for Females
WHO ²	0-3	$(60.9 \times \text{Wt}) - 54$	$(61.0 \times \text{Wt}) - 51$
	3-10	$(22.7 \times \text{Wt}) + 495$	$(22.5 \times \text{Wt}) + 499$
	10-18	$(17.5 \times \text{Wt}) + 651$	$(12.2 \times \text{Wt}) + 746$
Schofield ³	0-3	$(59.48 \times \text{Wt}) - 30.33$	$(58.29 \times \text{Wt}) - 31.05$
	3-10	$(22.7 \times \text{Wt}) + 505$	$(20.3 \times \text{Wt}) + 486$
	10-18	$(13.4 \times \text{Wt}) + 693$	$(17.7 \times \text{Wt}) + 659$
Schofield ³	0-3	$0.167 \times \text{Wt} + 1517.4 \times \text{Ht} - 617.6$	$16.25 \times \text{Wt} + 1023.2 \times \text{Ht} - 413.5$
	3-10	$19.6 \times \text{Wt} + 130.3 \times \text{Ht} + 414.9$	$16.97 \times \text{Wt} + 161.8 \times \text{Ht} + 371.2$
	10-18	$16.25 \times \text{Wt} + 137.2 \times \text{Ht} + 515.5$	$8.365 \times \text{Wt} + 465 \times \text{Ht} + 200$
Oxford ⁴	0-3	$(61.0 \times \text{Wt}) - 33.7$	$(58.9 \times \text{Wt}) - 23.1$
	3-10	$(23.3 \times \text{Wt}) + 514$	$(20.1 \times \text{Wt}) + 507$
	10-18	$(18.4 \times \text{Wt}) + 581$	$(11.1 \times \text{Wt}) + 761$

Abbreviations: REE, Resting Energy Expenditure (kcal/d); Ht, height (meters); Wt, weight (kg). REE should be multiplied by activity factor and possibly an injury/stress factor to estimate total energy expenditure (TEE)

Results: Condition-Specific Equations

Table 4. Condition-Specific Energy Requirements and Limitation Summary

Condition	Condition-Specific Calculation	Comments on Literary Origin of Condition-Specific Calculation
Down Syndrome	<ul style="list-style-type: none"> 14.3 kcal/cm for girls ages 5-11 years 16.1 kcal/cm for boys ages 5-11 years 	Based on the actual energy intake, not measured energy expenditure, of 23 institutionalized children, 5-11 years of age, with Down Syndrome ⁵
Spina bifida *For children older than 8 who are minimally active	To <u>maintain weight</u> : <ul style="list-style-type: none"> 9-11 kcal/cm OR <ul style="list-style-type: none"> 50% fewer kcal than recommended for a child of the same age without the condition To <u>promote weight loss</u> : <ul style="list-style-type: none"> 7 kcal/cm 	Based on the energy intake required to maintain growth of 14 children, six to 16 years of age, with myelomeningocele ⁶
Prader-Willi	To <u>maintain growth</u> within a growth channel: <ul style="list-style-type: none"> 10-11 kcal/cm For <u>slow weight loss</u> : <ul style="list-style-type: none"> 8-10 kcal/cm 	Based on a 1976 study of 14 children, 4 to 14 years of age, with Prader-Willi in which the actual energy intake required for growth and healthy weight was determined ⁷

Abbreviations: EER, Estimated Energy Requirement (See tables 3.5 & 3.6)
 Note: The Academy of Nutrition and Dietetics Pediatric Nutrition Care Manual recommends clinicians calculate the energy requirements from the DRI EER in addition to the appropriate condition-specific equation and use clinical judgement to determine a starting point

Conclusions/Next Steps

Given condition-specific energy requirements for children with DD lack validation and strong study design, it is recommended that RDNs use the both the DRI EER equations (Tables 1 and 2) in addition to appropriate condition-specific equations to determine a starting point for estimated energy requirements for a child with DD.

The RDNs should monitor growth on both condition-specific growth charts as well as growth charts for children with TD and adjust energy intake goal as appropriate in conjunction with biochemical, clinical, and diet assessments.

In addition to explaining key authoritative guidelines that should be considered by RDNs as they assess the energy needs of children with DD, this project also highlights the need for additional nutrition-related studies on children with DD to provide more accurate estimates of energy requirements. New studies should ideally have larger sample sizes, improved study design, and use the doubly labeled water method to track measure energy expenditure.

References

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