

FINAL REPORT:

Youth Compendium of Energy Expenditures Update: Systematic Review

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1.0 INTRODUCTION

The Youth Compendium of Energy Expenditures Update project was funded by FHI 360/National Collaborative on Childhood Obesity Research (NCCOR): FHI 360 Reference Project No. #4357-03-02-S-FU-01.

The project was established after a NCCOR sponsored Youth Energy Expenditure Workshop, held in Atlanta in April 2012, recommended that an updated and improved compendium of energy expenditures would contribute significantly to research and evaluation concerning the contributions of interventions and policy designed to increase physical activity for obesity prevention and control and for other health concerns. The original Youth Compendium of Energy Expenditures was originally published in 2008^[1] and has been used and referenced extensively (83 citations, Web of Science, Aug 2013). The 2008 Youth Compendium was created based a systematic review of the studies that measured the energy cost of children's activities^[2]. The review was limited to children aged 6.0-17.9 y and included articles published up to 2007. The expert workshop agreed that a revised compendium would benefit from a second systematic review to: locate studies published from 2007; widen the age range to all children and adolescents aged < 18 y; expand the databases used to search for relevant studies.

Dr. Kate Ridley, the first author of the 2008 Youth Compendium led the project with contribution from researchers based at Flinders University. Dr. David Berrigan (NCI) and Dr. Janet Fulton (CDC) collaborated on, and supervised the project. A Scientific Advisory Committee (SAC) comprising Dr. David Berrigan, Dr. Janet Fulton, Dr. Britni Belcher (NCI), Dr. Virginia Frederick (CDC) and Dr. Stephen Herrmann (University of Kansas) provided expert advice throughout the duration of the project.

This final report presents the results of the 2013 systematic review. The report: outlines the methods undertaken; provides the summarized energy cost data in a separate Microsoft Excel spreadsheet; summarizes and provides commentary on the results; and discusses the next research priorities working toward creating an updated, publicly available Youth Compendium of Energy Expenditures.

1. Ridley, K., B.E. Ainsworth, and T.S. Olds, *Development of a compendium of energy expenditures for youth*. Int J Behav Nutr Phys Act, 2008. **5**: p. 45.
2. Ridley, K. and T.S. Olds, *Assigning energy costs to activities in children: a review and synthesis*. Med Sci Sports Exerc, 2008. **40**(8): p. 1439-46.



2.0 METHODS

2.1 Eligibility criteria

Studies that met the following criteria were included in the review:

1. full-text article, thesis/dissertation, or data provided from authors from a published conference abstract;
2. not a systematic review or meta-analysis (all relevant systematic reviews and meta-analyses were screened for references before being subsequently excluded);
3. provided child/youth human (<18 y) data;
4. energy cost/expenditure (EE) of individual activities measured (i.e. not total daily EE or segmented day EE measured);
5. numerical energy cost data measured using a criterion method (i.e. indirect calorimetry, direct calorimetry and CO₂ breath tests) was provided;
6. participants were not selected based on specific pathology (excluding weight status).

2.3 Search strategy

A list of search terms was created and approved by the SAC. Two separate searches were undertaken.

The aim of the first search was to locate studies where the primary aim was to measure the energy cost of individual activities in children.

Search 1 search strategy:

Block 1:

child*, teen*, adolescen*, young*, youth*, pube*, pediat*, paediat*, girl*, boy*

Block 2:

“energy cost”, “energy expenditure”, “caloric expenditure”, “oxygen consumption”, “aerobic demands”, “oxygen uptake”, “metabolic cost”.

The terms within each block were combined with the Boolean command OR. Blocks were combined with the Boolean command AND.

The aim of the second search was to locate studies where the primary aim was to validate activity monitors (e.g. accelerometers, pedometers, etc.) using a protocol where the energy cost of individual activities in children were measured.

Search 2 search strategy:

Block 1:

child*, teen*, adolescen*, young*, youth*, pube*, pediat*, paediat*, girl*, boy*

Block 2:

“acceleromet*”, “pedomet*”, “heart rate”, “activity monitor”

Block 3:

“valid*”

The terms within each block were combined with the Boolean command OR. Blocks were combined with the Boolean command AND.

2.2 Information Sources

Studies were located primarily via electronic databases. The following databases were searched: CINAHL; Cochrane library; EMBASE; Medline; Proquest; PsychINFO; SCOPUS; SportDiscus; and Web of Science. In addition, reference lists of relevant reviews were scanned and some studies were located through contact with academic colleagues. No limits were applied for languages.

Two separate searches were undertaken trained researchers (n=2). Results were compared and no disparities were found (i.e. identical search results were found). Searches were undertaken on 20 March 2013. Once each database search was completed all studies were compiled into a single list with EndNote bibliographic software with all duplicates removed.

2.3 Study Selection

The trained researchers carried out eligibility assessment in a standardized manner, each screening one half of the list. Title, abstracts and keywords were assessed for initial eligibility. Those abstracts that met the eligibility criteria, or abstracts where more information was required prior to a decision regarding inclusion was made, were retrieved as full text. All studies retrieved as full text were then thoroughly assessed for inclusion. Any queries regarding eligibility were referred to the Principal Researcher (Dr. Kate Ridley) for resolution. Authors were contacted where possible to obtain missing data, clarify aspects of the study (e.g. protocol), etc.

2.4 Data Collection Process

Descriptive and quantitative data from each study were extracted by two trained research assistants using hard copy data extraction sheets (see Appendix 1). Hard copy data extraction sheets have been scanned and stored in a Dropbox® folder that can be shared with the SAC for reference and future analyses. Selected demographic and energy cost variables were then imported into an Excel spreadsheet. Description of the variables extracted onto the spreadsheet can be found in Table 3.0. Where studies reported multiple metrics of energy cost data, the following hierarchy was used to determine which metric to report in the Summary Data Spreadsheet: 1) VO₂; 2) KJ; 3) KCal; 4) METs (authors contacted in an attempt to obtain gross energy cost data when METs reported). The smallest unit time reported (e.g. per min) was used and per unit body mass (kg) used where available.

Approximately 38% of studies have been double coded. Double coding was undertaken by either: both trained research assistants; the Principal Researcher (Dr. Kate Ridley); or a member of the SAC. Very few anomalies were found and these typically related to missing information (e.g. missing demographic data written in text

rather than in tables) or choosing a different energy cost metric to extract, rather than inaccurate data being entered. Double coding of studies can continue to occur as further analyses and investigations are undertaken.

2.5 Walking/Running/Cycling studies

Due to the large number of studies that measured the energy cost of walking, running and cycling and the complexities of extracting and analyzing energy cost data collected at various speeds, inclines and cycling workloads; it was decided that walking, running and cycling data were not to be extracted for the purposes of this systematic review. Separate folders were created in the EndNote libraries to store manuscripts of studies that only measured the energy costs of these activities (see Fig.1. Prisma flow diagram of search results). The systematic review that informed the 2008 Youth Compendium performed separate analyses on the walking and running datasets (much smaller amount of studies located). The wider youth EE expert panel could be consulted on whether conducting separate analyses for walking and running constitutes a worthwhile separate subsequent project to inform an updated compendium.

3.0 RESULTS

3.1 Search results

Tables 1.0 and 2.0 report the number of hits per database and per block. Figure 1.0 presents a Prisma flow diagram of the search results including details of the number of articles included and excluded at each stage throughout the search and screening processes.

Table 1.0 Number of hits per database for Search # 1. Total hits = 18,513.

Database	Title	Abstract	Keyword	Ti/Abs/Keywords
CINAHL	BLOCK 1 = 135,834 BLOCK 2 = 1,679	BLOCK 1 = 185,285 BLOCK 2 = 5,757	BLOCK 1 = 254,130 BLOCK 2 = 8,237	BLOCK 1 = 361,758 BLOCK 2 = 11,290 COMBINED = 2,866
Cochrane Library	N/A	N/A	N/A	BLOCK 1 = 118,806 BLOCK 2 = 7,989 COMBINED = 1,008
Embase	BLOCK 1 = 819,468 BLOCK 2 = 16,805	BLOCK 1 = 1,173,154 BLOCK 2 = 70,986	BLOCK 1 = 142,014 BLOCK 2 = 9,153	BLOCK 1 = 1,507,224 BLOCK 2 = 79,669 COMBINED = 4,340
Medline	BLOCK 1 = 620,065 BLOCK 2 = 12,978	BLOCK 1 = 808,167 BLOCK 2 = 52,285	BLOCK 1 = 29,621 BLOCK 2 = 60	BLOCK 1 = 1,089,115 BLOCK 2 = 57,705 COMBINED = 3,149
Proquest	BLOCK 1 = 96,958 BLOCK 2 = 868	BLOCK 1 = 160,031 BLOCK 2 = 4,689	BLOCK 1 = 32,098 BLOCK 2 = 279	BLOCK 1 = 191,441 BLOCK 2 = 5,131 COMBINED = 226
PsychINFO	BLOCK 1 = 320,398 BLOCK 2 = 434	BLOCK 1 = 547,785 BLOCK 2 = 2,806	BLOCK 1 = 285,596 BLOCK 2 = 1,038	BLOCK 1 = 616,026 BLOCK 2 = 3,063 COMBINED = 316
	BLOCK 1 = 50,273	BLOCK 1 = 73,750	BLOCK 1 = 6,754	BLOCK 1 = 97,584

SportDiscus	BLOCK 2 = 3,614	BLOCK 2 = 10,043	BLOCK 2 = 1,380	BLOCK 2 = 12,239 COMBINED = 1,295
Web of Science	N/A	N/A	N/A	BLOCK 1 = 1,135,108 BLOCK 2 = 68,985 COMBINED = 5,313

Table 2.0 Number of hits per database for Search # 2. Total hits = 3,408.

Database	Title	Abstract	Keyword	Ti/Abs/Keywords
CINAHL	BLOCK 1 = 135,834 BLOCK 2 = 2,840 BLOCK 3 = 13,200	BLOCK 1 = 185,285 BLOCK 2 = 10,950 BLOCK 3 = 45,100	BLOCK 1 = 254,130 BLOCK 2 = 15,221 BLOCK 3 = 42,812	BLOCK 1 = 361,758 BLOCK 2 = 19,963 BLOCK 3 = 75,718 COMBINED = 533
Cochrane Library	N/A	N/A	N/A	BLOCK 1 = 118,806 BLOCK 2 = 29,040 BLOCK 3 = 13,586 COMBINED = 86
Embase	BLOCK 1 = 819,468 BLOCK 2 = 25,029 BLOCK 3 = 74,149	BLOCK 1 = 1,173,154 BLOCK 2 = 150,814 BLOCK 3 = 435,244	BLOCK 1 = 142,014 BLOCK 2 = 15,763 BLOCK 3 = 20,472	BLOCK 1 = 1,507,224 BLOCK 2 = 159,242 BLOCK 3 = 462,679 COMBINED = 675
Medline	BLOCK 1 = 620,065 BLOCK 2 = 19,432 BLOCK 3 = 57,277	BLOCK 1 = 808,167 BLOCK 2 = 113,317 BLOCK 3 = 330,381	BLOCK 1 = 29,621 BLOCK 2 = 627 BLOCK 3 = 99	BLOCK 1 = 1,089,115 BLOCK 2 = 119,068 BLOCK 3 = 348,974 COMBINED = 492
Proquest	BLOCK 1 = 96,958 BLOCK 2 = 1,211 BLOCK 3 = 12,296	BLOCK 1 = 160,031 BLOCK 2 = 6,978 BLOCK 3 = 114,995	BLOCK 1 = 32,098 BLOCK 2 = 543 BLOCK 3 = 1,565	BLOCK 1 = 191,441 BLOCK 2 = 7,496 BLOCK 3 = 119,465 COMBINED = 68
PsychINFO	BLOCK 1 = 320,398 BLOCK 2 = 3,365 BLOCK 3 = 35,853	BLOCK 1 = 547,785 BLOCK 2 = 15,787 BLOCK 3 = 143,809	BLOCK 1 = 285,596 BLOCK 2 = 7,572 BLOCK 3 = 61,817	BLOCK 1 = 616,026 BLOCK 2 = 17,066 BLOCK 3 = 161,102 COMBINED = 118
SportDiscus	BLOCK 1 = 50,273 BLOCK 2 = 4,326 BLOCK 3 = 6,042	BLOCK 1 = 73,750 BLOCK 2 = 14,918 BLOCK 3 = 18,259	BLOCK 1 = 6,754 BLOCK 2 = 2,408 BLOCK 3 = 960	BLOCK 1 = 97,584 BLOCK 2 = 16,891 BLOCK 3 = 20,335 COMBINED = 308
Web of Science	N/A	N/A	N/A	BLOCK 1 = 1,135,108 BLOCK 2 = 112,623 BLOCK 3 = 795,396 COMBINED = 1,128

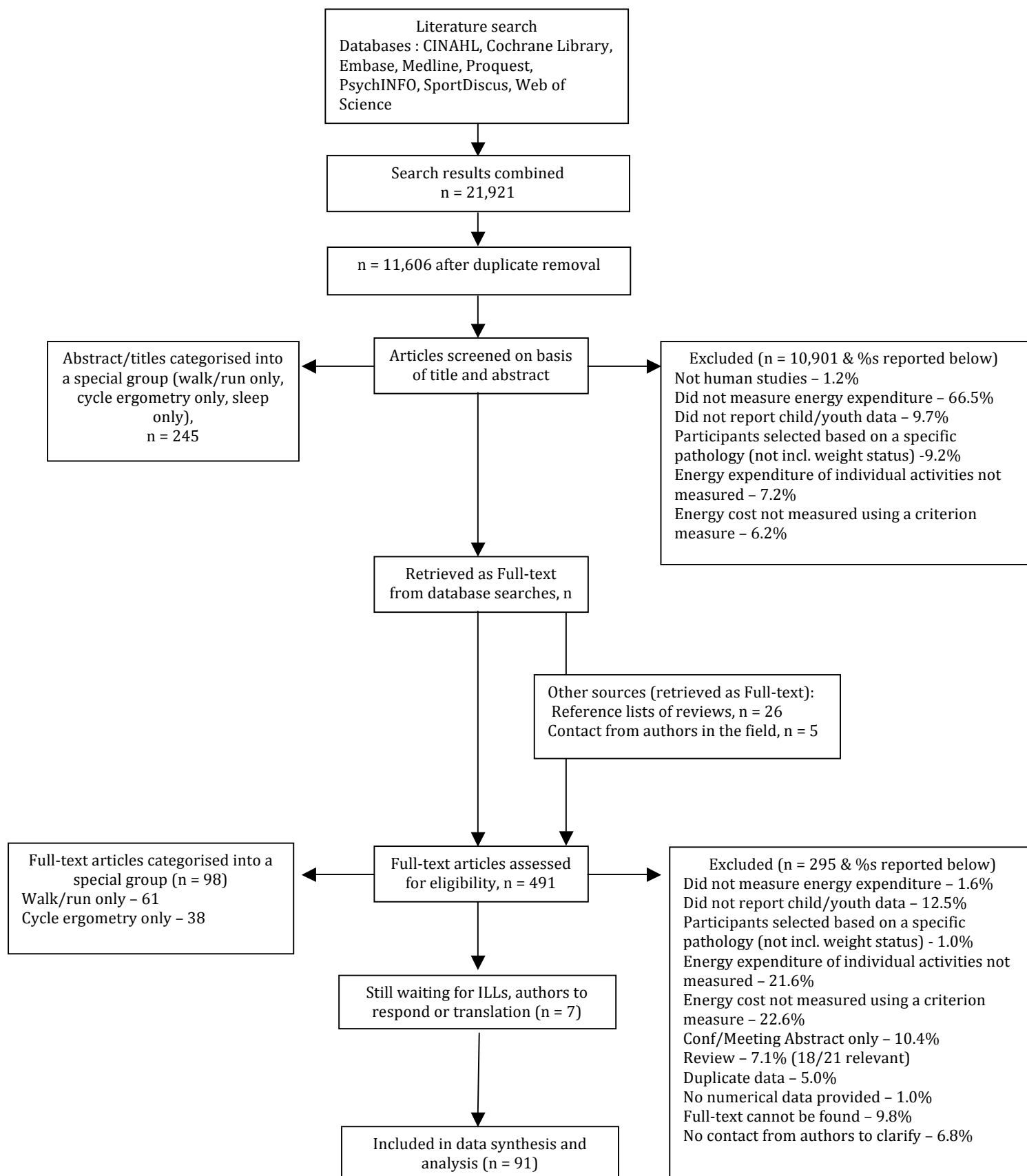


Figure 1.0 Prisma flow chart of search results

3.2 Systematic review results

The results of the systematic review can be found in the supplementary Excel Spreadsheet “YouthEESystematicReviewData.xlsx” file. The first worksheet in the spreadsheet (labeled “Included Studies”) provides the full reference for each included study. The second worksheet (labeled “Data”) provides the summary data for the extracted variables. A description of the extracted variables can be found in Table 3.0. Asterisks (*) were used where the relevant data were not provided within the publications. The third worksheet (labeled “Incl. 2008 comp highlighted”) shows the studies that were included in the 2008 compendium highlighted in yellow.

The *Filter* function in Excel can be used to restrict the view to variables of interest (e.g. all data collected using a room calorimeter). To undertake filtering, select the entire spreadsheet and then click filter. Once filtering is turned on, click the arrow in the column header to choose a filter for that column.

Table 3.0 Description of the extracted variables

Variable name	Variable descriptor
Article ID	A unique ID number for each article derived from the initials of the first author (first name, surname), the year of publication, an underscore_ followed by the first page number of the publication, e.g: AA2012_994. The word “thesis” is used to identify dissertations/theses rather than a page number.
Year of pub	Year of publication
Age (mean)	Mean age of the sample/stratum
Age (SD)	Standard deviation (SD) of the age of the sample/stratum
Age (range)	Range of ages within the sample/stratum
n	Sample/stratum size
n M	Number of males within the sample/stratum
n F	Number of females within the sample/stratum
Strata	A description of the stratum to which the data within the row belongs, e.g. boys/girls; age groups; strata determined by weight status (ow/ob, etc). ES = entire sample.
Additional strata?	A y/n (yes/no) variable that specifies whether the data in the row have already been provided in the spreadsheet within another strata (i.e. “y”). For example, a publication may present the mean data of the entire sample (ES), and then stratify these data and present means by age group. The rows that contain the ES data will be designated “n” and the rows that contain the age group data will be designated “y”. This variable can be used to filter out replicated data using Excel’s Filter tool option for the purpose of calculating total n’s, weighted means for the entire sample, etc.
mass (kg) (mean)	Mean mass in kg of the sample/stratum

mass (kg) (SD)	SD of the mass in kg of the sample/stratum
height (cm) (mean)	Mean height in cm of the sample/stratum
height (cm) (SD)	SD of the height in cm of the sample/stratum
# of measures (if different to n)	The number of energy cost measures undertaken for the activity designated in this row. This may vary from the n of the sample/stratum (column F) when either 1) repeated measures have been taken on each individual or 2) measures were not taken on every participant (n) <i>but</i> demographic details only provided for n. This variable should be used to calculate n for the purpose of calculating weighted mean energy costs.
Activity	A short descriptive name of the activity undertaken for which energy cost has been measured. This name is based on the authors' description/naming of the activity. More detailed descriptions of the activity may be found in the <i>Notes</i> section (column AB) or via the scanned data extraction forms.
Activity Category	Categories created by Dr Kate Ridley to facilitate summary and analysis of data. See 3.X Categories of Activities.
E Cost measure	The method used to measure energy cost data, i.e: indirect calorimetry or direct (room) calorimetry. Further information regarding the type of indirect calorimetry equipment used (e.g. portable analyser, Douglas Bags, a metabolic cart, etc) can be sourced from the data extraction sheets. Note: While the data extraction forms also provided an option for CO ₂ breath tests, the only publications that used this measure also measured energy cost using indirect calorimetry, therefore this measure was extracted.
E cost unit	The unit/metric that was used to present energy cost data. Where multiple metrics were provided, the following hierarchy was used to extract data: 1) VO ₂ ; 2) KJ; 3) KCal; 4) METs.
Measured E cost (mean)	Mean energy cost for the designated activity and sample/stratum in each row.
Measured E cost (SD)	SD of the energy cost for the designated activity and sample/stratum in each row.
Other measure of variability	Any other measure of variability provided in the paper. The type of variability measure (e.g. range, %CV) is listed in the Notes column.
RMR unit	Only studies that referred to their measures as RMR or BMR are listed here. Studies that referred to their measures as sitting resting or lying resting have been added to the activities list (column P) and typically named "sitting quietly" or "lying quietly"
Measured RMR (mean)	Mean measured RMR/BMR for the designated sample/stratum in each row.
Measured RMR (SD)	SD of the measured RMR/BMR for the designated sample/stratum in each row.
Estimated RMR (mean)	Mean estimated RMR/BMR for the designated sample/stratum in each row.

Estimated RMR (SD)	SD of the estimated RMR/BMR for the designated sample/stratum in each row.
Notes	Relevant notes regarding the data presented in the row are listed here.
Converted to $\text{VO}_2 \text{ ml.kg}^{-1} \cdot \text{min}^{-1}$	Where possible, energy cost data not provided as $\text{V}\square\text{O}_2 \text{ ml.kg}^{-1} \cdot \text{min}^{-1}$ are converted to this base metric for comparative purposes. Data not provided per unit mass were converted using the mean mass provided. Data presented in KCals were first converted to KJs using the correction factor of 1 Kcal = 4.18 KJ. KJs were converted to VO_2 using a standard energy equivalent for oxygen uptake: $20.9 \text{ kJ.L}^{-1} \text{ O}_2$.
Run/Walk also measured?	This column was created to enable notation of studies where running and/or walking data were also measured but not extracted due to the revised scope of the systematic review. However, as research assistants were not directed to fill this column in, there are many missing data (*). Data extraction forms can be used to complete this column.
Cycle also measured	As above in reference to cycling
Incl in 2008 compendium?	A y/n (yes/no) variable that specifies whether the data in the row were included in the 2008 Youth Compendium of Energy Expenditures

3.3 Categories of Activities

Due to the many and varied names authors used to describe the activities measured, categories of similar activities have been created to facilitate summary and analysis of data. These categories were created subjectively by the Principal Researcher and have not been based on any other activity classification system [e.g. not based on Ainsworth Adult compendium or Multimedia Activity Recall for Children and Adults (MARCA) coding systems]. As such, new or revised categories can be implemented as recommended by the SAC or wider expert Youth EE group.

3.4 Summary of Results

A total of 91 eligible studies were included for data extraction in the systematic review. Studies were from published from 1948-2013 (excluding the 1923 Bedale study – see notes in Excel spreadsheet). Mean ages in the studies ranged from 4.7 y to 17.3 y.

A total of 487 unique mean energy costs values (i.e. number of rows of data where one row represents one mean energy cost value for a sample or stratum) were extracted. Additional data rows (n=141) exist where data had been re-analyzed and presented by different strata.

Note: the number of mean energy cost values DO NOT relate to the number of participants that were measured for each activity across the studies, rather the number of separate mean scores that were provided. Summaries based on number of participants can also be calculated from the spreadsheet and will be quoted if/when weighted means are calculated for each activity.

Table 4.0 Number of unique mean energy cost values in review categorized by activity type

Activity Category	Number of mean energy cost values (i.e. one row represents one mean energy cost value for a sample or stratum). No duplicate data are shown here.
Active outdoor play	26
Active video games	79
Arcade games	5
Arts and crafts	13
Chores	35
Dance/aerobics/calisthenics/gymnastics	31
Hiking/skiing	2
Lying/sitting/standing quietly	54
Marching with/without load	4
Playing musical instruments/singing	6
Reading/writing/academic pursuits	29
Sedentary play	23
Sedentary screen time	86
Self care	4
Simulated sports/games	45
Sitting talking/listening to music	3
Slide board	5
Standing playing or carrying toys	3
Step ups/climbing stairs	21
Strength exercises	6
Swimming/synchronized swimming	7
TOTAL	487

3.5 New studies not within 2008 Youth Compendium of Energy Expenditures

A total of 71 new studies were located that were not used in the 2008 Youth Compendium of EEs, corresponding to a total of 347 new mean energy cost values. Primarily, the new studies identified were either published since 2007 or were undertaken on participants aged 0.0-5.9 y. However, new studies published prior to 2007 on children and youth aged 6.0-17.9 y were located due to the wider search (more databases and greater search terms) and the inclusion of children selected

based on weight status (not included in 2008). A summary of the most prolific activity categories within the new data collated can be found in Table 4.0. Of the new studies identified, the majority of activities measured were video games, in particular active video games. While a number of new studies measured simulated sports and games, the types of sports/games measured were similar to those already based on measures in children in the 2008 compendium (i.e. basketball, throw and catch). Nevertheless, a number of new sports/games measures were located in the 2013 search, including soccer skills, volleyball, floor hockey and table tennis. In addition, for all activities the depth and breadth of evidence (e.g. in relation to total number of measures and breadth of ages, more diverse groups, etc) has improved substantially.

Table 5.0 Number of unique mean energy cost values in review categorized by activity type that were NOT included in 2008 Youth EE compendium.

Activity Category	Number of mean energy cost values (i.e. one row represents one mean energy cost value for a sample or stratum). No duplicate data are shown here.	% of total new data points
Active video games	79	22.8%
Sedentary screen time	61	17.6%
Lying/sitting/standing quietly	44	12.7%
Simulated sports/games	39	11.2%
Dance/aerobics/calisthenics/gymnastics	27	7.8%
Active outdoor play	18	5.2%
Chores	15	4.3%
Reading/writing/academic pursuits	15	4.3%
Sedentary play	15	4.3%

Note: remaining ~ 10% of activities spread across remaining activity categories.

4.0 RECOMMENDATIONS FOR NEXT STEPS

It is recommended that the data located in this systematic review be summarized into weighted means for inclusion into a newly derived youth compendium of energy expenditures. However a number of very important decisions need to be made prior to undertaking these analyses.

These include:

1) Which data to include?

Some data may be considered ineligible due to a lack of generalisability to wider populations (e.g. based on weight status, protocol of activity undertaken, decade that data were collected, etc.).

2) Which metric to use?

Currently the collated data from the systematic review are presented in 1) the metric presented in the paper & 2) converted to oxygen uptake in $\text{ml.kg}^{-1}.\text{min}^{-1}$ (where sufficient data were available to calculate) for comparison purposes. The common metric of $\text{VO}_2 \text{ ml.kg}^{-1}.\text{min}^{-1}$ was calculated within the collated data spreadsheet as indirect calorimetry was the most commonly used measure of energy costs across studies. If a common unit of EE (either KJ or KCal), rather than VO_2 is desired, the EE data presented in the spreadsheet should be used. For those studies, where VO_2 data are reported in the spreadsheet, the data could be calculated using the reverse correction factor OR for more accurate results, extraction sheets could be checked for those papers that reported EE (in KJ or KCal) in addition to VO_2 data. These data would be a more accurate estimation of EE using Weir's formula, which requires the input of VO_2 and VCO_2 , rather than the standard correction factor of $21\text{kJ.L}^{-1} \text{O}_2$ used to calculate VO_2 .

It is not recommended that a published version of a youth compendium would present energy cost data in $\text{VO}_2 \text{ ml.kg}^{-1}.\text{min}^{-1}$. There remains uncertainty regarding the most appropriate metric to present energy costs in children, however the analyses undertaken by another sub-group of the Youth EE Expert Panel have identified scaled VO_2 (per $\text{kg}^{0.75}$) and the child MET (measured energy cost/child RMR) as the best options. Both metrics pose issues in relation to the data collected within the systematic review. The scaled VO_2 option requires individual level data which is available in very few of the studies identified. The child MET option is likely to require an estimation of RMR using the Schofield equations, or similar. These equations are age- and sex-specific and require entry of mass in kgs. Not all studies provide mass data and many only present mass data for the entire sample, not separately for boys and girls.

Note: IF Schofield equations are used to generate BMR to calculate METs, it is recommended that the data extraction forms are referred to in order to ascertain whether demographics (specifically mass) were also reported separately despite only having an ES energy cost provided (e.g. RM2007_334 provides energy cost data for the entire sample, but also provided mass by sex).

Due to the lack of data across different ages for most activities, it is unlikely that age-correction factors will be able to be calculated and provided within the compendium. Therefore, it is recommended that consideration be given to presenting under age groups (e.g. Early Childhood 4-6 y; Childhood 7-12 and Adolescents 13-17 y).

3) How to deal with activities where no data are available?

In the 2008 compendium, a hierarchy of data allocation techniques was used to assign energy costs to activities where no child-specific data were available. This was largely due to the compendium being used within the self-report software

program the MARCA, which requires an energy cost value for all selectable activities. This approach may be abandoned when creating a revised compendium. It may be wiser to present available data, including details of the sample(s) used to derive the mean energy cost values, under easily distinguishable activity categories and allowing researchers to make their own informed decisions of how to allocate energy cost data to missing activities. A list of considerations and recommendations could be provided (e.g. the consequences of using adult METs, etc).

4) How to collate/collect new data?

A plan to collate and collect new data should be established. It is likely that a number of researchers hold relevant "grey data". A small number of authors commented on their grey data in emails regarding the systematic review. Details of these correspondences have been saved. A process to seek out and screen these data could be established. An incentive, such as publication in a special issue of a relevant journal, may assist in this process. Workshops, sponsored sessions at relevant conferences would be useful in 'spreading the word' amongst researchers.

As energy cost data are continually being published, a process for continual update should be established. A updated systematic search every 12-24 months may be possible.

It is also clear that the same types of activities are being measured repeatedly. In order to establish areas of greatest need some additional research could be undertaken. One possible avenue of research is to compare data from time use surveys (or similar) to determine what activities children of varying ages typically perform and how well these are represented in the available energy cost data. This information could be used to create a list of priority activities and associated age groups to distribute to relevant research groups. Funding and/or publication avenues to support this process should be considered.

It is strongly recommended that the wider Youth EE expert panel be involved in discussing these issues and reaching a consensus.

Attachments

- 1) Youth EE data extraction form.doc**
- 2) YouthEESystematicReviewData.xlsx**

Any queries regarding the Youth EE Systematic Review Data or Report are welcomed and can be directed to Dr. Kate Ridley.



Sept 3, 2013.