Brief report

Prevalence of Energy Intake Misreporting in Malay Children Varies Based on Application of Different Cut Points

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Summary

This study aimed to identify the prevalence of energy misreporting amongst a sample of Malay children aged 9–11 years (n = 14) using a range of commonly used cut points. Participants were interviewed using repeated 24 h dietary recalls over three occasions. The Goldberg equations (1991 and 2000), Torun cut points and the Black and Cole method were applied to the data. Up to 11 of 14 children were classified as misreporters, with more under-reporters (between seven and eight children) than over-reporters (four or less children). There were significant differences in the proportion of children classified as energy misreporters when applying basal metabolic rate calculated using FAO/UNU/WHO (1985) and Malaysian-specific equations (p < 0.05). The results show that energy misreporting is common amongst Malay children, varying according to cut point chosen. Objective evaluation of total energy expenditure would help identify which cut point is appropriate for use in Malay paediatric populations.

Background

Accurate dietary reporting is important both at individual and population levels when investigating relationships between dietary intake and health status [1, 2]. Assessing children’s dietary intake is particularly challenging owing to age-related ability to self-report [2–5], whether parents are reasonable or accurate proxies and other factors [6, 7].

Dietary misreporting undermines the validity of reported energy intakes [8] and could attenuate results evaluating diet and weight status relationships, increasing the risk of a type 2 error when assessing effectiveness of dietary intervention programmes. Although under-reporting is commonly reported [8, 9], over-reporting is less often evaluated but could potentially be more prevalent amongst children [4].

In the absence of direct measures of total energy expenditure such as doubly labelled water, cut points can be used to identify misreporters [7]. While there are no international standards, Goldberg equations [9, 10], Torun cut point [11] and Black and Cole [12] methods are commonly used.

The degree of energy misreporting among Malaysian children has rarely been investigated. The aim of this article was to identify the prevalence of energy misreporting amongst a sample of Malay children by applying commonly used cut points.

Subjects and Methods

Study population

Participants were children aged 9–11 years recruited from a national primary school in Kuala Lumpur, whose families provided written informed consent. Inclusion criteria were Malay family with main carer(s) living full time with his/her child who had...
no concurrent medical conditions. Approval was obtained from the ethics committees of University of Newcastle and International Medical University, Malaysia.

**Measurements**

**Dietary intake.** Participants were interviewed at home or school between August and September 2013 using repeated 24 h dietary recalls method on two weekdays and one weekend day. The 24 h dietary recalls adapted the protocols of United States Department of Agriculture’s Automated Multiple Pass Method [13] and the Australian National Nutrition Survey 1995 [14] 24 h dietary recall procedures. Information on foods and beverages consumed the day prior to interview was collected using a five-phase approach [13] supported by food photographs and local household measures. The recalls were analysed using Nutritionist Pro™ and nutrient data from the Malaysian Nutrient Composition of Foods (1997) [15] and Singapore Nutrient Composition of Foods databases [16].

**Anthropometric measures.** Participants were weighed in light clothing on portable scales (TANITA Corporation Japan). Height was measured with microtoise (SECA Bodymeter 206, Germany). Body mass index (BMI) was calculated according to standardized equations and categorized using World Health Organisation BMI-for-age Z scores (5–19 years old) [17].

**Table 1**

*Cut points used to determine energy misreporting*

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<tr>
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<tbody>
<tr>
<td>Identify under-reporters based on EI:BMR ratio (&lt;1.35)</td>
<td>Boys: &lt;1.39 (UR), 1.39–2.24 (AR), &gt;2.24 (OR)</td>
<td>Classifies under, acceptable and over-reporters</td>
<td>Cut points based on 95% confidence limits of agreement between EI and total EE measured by doubly labelled water</td>
</tr>
<tr>
<td>No longer recommended</td>
<td>Girls: &lt;1.30 (UR), 1.30–2.10 (AR), &gt;2.10 (OR)</td>
<td>Cut-off values are the confidence limit of agreement between EI:BMR and PAL [95% CL = PAL × exp (±2 × S/100)/√n]</td>
<td>Classifies under, acceptable and over-reporters based on EI: estimated EE ratio of &lt;0.76 (UR), 0.76–1.24 (AR), &gt;1.24 (OR)</td>
</tr>
</tbody>
</table>

AR, acceptable reporter; BMR, basal metabolic rate; CL, confidence limit; EE, energy expenditure; EI, energy intake; OR, over-reporter; PAL, physical activity level; UR, under-reporter.

**Results**

Fourteen families completed data for all measures. Descriptive characteristics of the 14 children are
shown in Table 2. No between-sex differences were observed for age, anthropometric measures or energy intake ($p > 0.05$).

Energy misreporting was prevalent in 11 (78.4%) of 14 children (Table 3). Seven to eight children under-reported compared with four or fewer over-reporters, and misreporting was independent of body weight status. Nine participants were classified into the same category of energy reporting for all three cut points. Use of newer methods [9, 12] resulted in a higher proportion of over-reporters (up to 28.5%). No outliers in energy intake were found in this small sample. Nine children (64%) did not meet the RNI for energy, while four children exceeded it.

**Discussion**

This article is the first to report the prevalence of energy misreporting in Malaysian children according to different cut points. Both under- and over-reporting were more prevalent than in other children dietary studies [24, 25].

More over-reporters were identified when PAL or energy expenditure was included in the analysis. Misreporting was increased by using Goldberg [9] and Black and Cole [12], specifically the upper confidence limit. The inclusion of measures of energy output factors accounts for physiological variability within the population under study, increasing the validity of the cut point method.

Knowledge of population-specific BMR is valuable when applying cut points to avoid misclassification. In this study, fewer under-reporters were identified using Malaysian BMR classifications, partly due to overestimation of BMR using the FAO/WHO/UNU (1985) predictive equations [19].

Unsurprisingly, given the proportion of under-reporters, the majority of the children’s energy intakes were below the RNI, which was based on the FAO/WHO/UNU method of estimating energy requirements for Malaysian children and adolescents [23].

**Table 2**

**Participant characteristics ($n = 14$), Median (IQR)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Boys ($n = 8$)</th>
<th>Girls ($n = 6$)</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>10.0 (9.8, 11.4)</td>
<td>10.3 (10.2, 10.5)</td>
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<tr>
<td>Weight (kg)</td>
<td>36.0 (26.4, 45.8)</td>
<td>36.9 (22.7, 38.0)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>134.6 (131.0, 144.2)</td>
<td>136.8 (128.5, 145.1)</td>
</tr>
<tr>
<td>Energy (kcal/day)</td>
<td>1531 (1141, 2038)</td>
<td>1558 (988, 2177)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>19.1 (14.1, 25.3)</td>
<td>18.4 (13.7, 20.9)</td>
</tr>
<tr>
<td>BMI Category:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe thinness</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Thinness</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Normal</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Overweight</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Obese</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 3**

Energy misreporting classification using various cut points ($n = 14$)

<table>
<thead>
<tr>
<th>Classification of misreporting</th>
<th>Different combination of BMR predictive equations and cut points</th>
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<tbody>
<tr>
<td>Under-reporters</td>
<td>BMR (WHO, 1985) and Goldberg (MAL, 1991)</td>
</tr>
<tr>
<td>Acceptable reporters</td>
<td>BMR (WHO, 1985) and Black and Cole (MAL, 2000)</td>
</tr>
<tr>
<td>Over-reporters</td>
<td>EEE (WHO, 2005) and Goldberg (MAL, 2005)</td>
</tr>
<tr>
<td></td>
<td>BMR (WHO, 1985) and Torun (1991)</td>
</tr>
<tr>
<td></td>
<td>BMR (WHO, 1985) and Goldberg (MAL, 1991) and Goldberg (MAL, 2000)</td>
</tr>
<tr>
<td></td>
<td>BMR (WHO, 1985) and Black and Cole (MAL, 2000)</td>
</tr>
</tbody>
</table>

BMR, basal metabolic rate; WHO, World Health Organization; MAL, Malaysian-specific; EEE, estimated energy requirement; NA, not applicable.

*PAL factor of 1.55.
Conclusion

Energy misreporting, particularly under-reporting, is common amongst Malay children and varies with cut point applied. Objective evaluation of total energy expenditure using doubly labelled water would help identify which cut points method is most accurate in the Malay paediatric population.

References