Introduction

• Pediatric weight is used to guide nearly all therapeutic interventions in children, yet calibrated scales are not always available or accessible in selected health care settings (e.g. developing countries; trauma/emergency settings).

• Numerous weight estimation strategies have been devised to assist health care providers with weight estimation in children. All published weight estimation methods have been tested in neurotypical children. However, to date, the performance of these methods has not been examined in children with Down syndrome.

• In 691 children in the United States are born with Down syndrome and virtually all need medical care throughout their lives. Children with Down syndrome experience differences in height and weight for age as compared with neurotypical children. These factors could potentially affect the accuracy of weight estimation.

• We chose to evaluate the performance of four commonly used weight estimation methods [Advanced Pediatric Life Support (APLS)17, Broselow18, Cattermole19, and Nelson20] along with the newly devised Mercy method21 in this prospective study of children with Down syndrome.

Methods

• Children 2 to 16 yr of age were enrolled under a protocol reviewed and approved by the Institutional Review Board at Children’s Mercy Hospital.

• Participants were enrolled with parental consent from the Guild of Greater Kansas City. Review and approved by the Institutional Review Board at University of Missouri-Kansas City School of Medicine, Children’s Mercy Hospital.

• Exclusion criteria included: known or apparent limb deformities, inability to be positioned for height/length measurements, underlying pathological condition or pharmacological management that could produce abnormal body composition for age (e.g. severe edema, chronic oral corticosteroid use).

Methods (cont’d)

• Qualified raters measured each participant’s length, weight, humeral length (HL), and mid upper arm circumference (MUAC).

• Data entry measurements were independently verified for accuracy against the data collection forms and then used to estimate the weight of each child as described for each of the methods. 3, 10-11, 13-15

• Estimated weight was compared to the actual weight of each child using common descriptive statistics (mean error [ME], mean percentage error [MPE] and root mean square error [RMSE]). Bland-Altman plots were constructed to evaluate agreement between the measures.

Results

•286 children (mean ± SD: 5.6 ± 4.3 yr, 21.9 ± 15.3 kg, 18.8 ± 4.1 kg/m²) met the inclusion requirements of the study.

•Only the Mercy method predicted weight in 100% of the participants with the remaining methods ranging from 30-95% (Table).

•Bias varied markedly between methods with every method except Cattermole underestimating weight across the population of children with Down syndrome (Table).

•The Mercy method estimated the highest percent of weights within 20% of actual weight and had tighter limits of agreement (LOA) than did the other methods (Figure).

Conclusion

•Of the five methods evaluated, the method which used both weight and length (Mercy) outperformed the methods based on a single variable.

•Age based methods were imprecise, overestimating weight in children who were underweight and underestimating weight in children who were overweight/obese.

•The characteristic short stature associated with Down syndrome caused the habitus-based method (Cattermole) to overestimate weight and the length based method (Broselow) to underestimate weight in nearly all children.

•Limitations to the study include possible inconsistencies of measurements due to multiple raters and use of participants from a limited geographic area.

•Among the methods evaluated, Mercy appears to be the safest method to employ when weight estimation for dosing medications is required in children with Down syndrome. The use of APLS, Cattermole, and Nelson are not acceptable in this population.

•All methods could benefit from adjustments in their formulae to minimize weight estimation error in children with Down Syndrome.

References


11. Taliercic et al. Measuring Circumference: Should we use the circumference of the arm or the hand to estimate weight in children? Arch Dis Child 2003; 88: 613-617.