Contents

PEA POD

General Validations

An Evaluation of the Pea Pod System for Assessing Body Composition of Moderately Premature Infants

Forsum E, Olhager E and Törnqvist C - Nutrients 2016, 8(4), 238

OBJECTIVE: Assessing the quality of growth in premature infants is important in order to be able to provide them with optimal nutrition. The Pea Pod device, based on air displacement plethysmography, is able to assess body composition of infants. However, this method has not been sufficiently evaluated in premature infants.

METHODOLOGY: In 14 infants in an age range of 3–7 days, born after 32–35 completed weeks of gestation, body weight, body volume, fat-free mass density (predicted by the Pea Pod software), and total body water (isotope dilution) were assessed. Reference estimates of fat-free mass density and body composition were obtained using a three-component model.

RESULTS: Fat-free mass density values, predicted using Pea Pod, were biased but not significantly ($p > 0.05$) different from reference estimates. Body fat (%), assessed using Pea Pod, was not significantly different from reference estimates. The biological variability of fat-free mass density was 0.55% of the average value (1.0627 g/mL).

CONCLUSIONS: The results indicate that the Pea Pod system is accurate for groups of newborn, moderately premature infants. However, more studies where this system is used for premature infants are needed, and we provide suggestions regarding how to develop this area.

Evaluation of air-displacement plethysmography for body composition assessment in preterm infants.

Roggero P, Giannì ML, Amato O, Piemontese P, Morniroli D, Wong WW, Mosca F. Pediatr Res. 2012 Sep;72(3):316-20. doi: 10.1038/pr.2012.75. Epub 2012 Jun 5.

PURPOSE: Adiposity may contribute to the future risk of disease. The aim of this study was to evaluate the accuracy and reliability of an air-displacement plethysmography (ADP) system to estimate percentage fat mass (%FM) in preterm infants and to evaluate interdevice reliability in infants.

METHODOLOGY: A total of 70 preterm and 9 full-term infants were assessed. The accuracy of ADP measurements was assessed by determining reference %FM values using H(2)(18)O dilution measurement.

RESULTS: Mean %FM by ADP was 5.67 ± 1.84 and mean %FM by H(2)18O dilution was 5.99 ± 2.56. Regression analysis showed that %FM by ADP was associated with %FM by H(2)(18)O dilution ($R2 = 0.63$, SE of estimate (SEE) = 1.65, $P = 0.006$). Bland-Altman analysis showed no bias ($r = -0.48$, $P = 0.16$) and 95% limits of agreement were -3.40 to 2.76 %FM. There was no difference in mean interdevice reliability %FM values (8.97 vs. 8.55 %FM) between ADP 1 and 2. Regression analysis indicated a low SEE (1.14% FM) and high R2 (0.91); 95% limits of agreement were -1.87 to 2.71 %FM. The regression line did not differ significantly from the line of identity.

CONCLUSIONS: ADP is a noninvasive, reliable, and accurate technique to measure preterm infants' body composition in both research and clinical settings.

Air-displacement plethysmography for determining body composition in neonates: validation using live piglets.

Frondas-Chauty A, Louveau I, Le Huërou-Luron I, Rozé JC, Darmaun D. Pediatr Res. 2012 Jul;72(1):26-31. doi: 10.1038/pr.2012.35. Epub 2012 Mar 22.

PURPOSE: Air-displacement plethysmography (ADP) was developed as a noninvasive tool to assess body composition, i.e., the proportion of fat mass (%FM) and lean body mass. The results of previous studies comparing ADP with labeled water dilution in infants and with chemical analysis in phantoms have validated the ADP approach indirectly. We assessed the precision and accuracy of measurements of % FM proportions in live animals, using ADP in comparison with biochemical analyses.

METHODOLOGY: Three groups of 12 piglets each underwent four consecutive body composition assessments at 2, 7, and 21 d and were euthanized to determine whole-body lipid content by direct chemical analysis.

RESULTS: The average body weights were 1,490, 2,210, and 5,610 g at d2, d7, and d21, respectively. The mean %FM values determined by biochemical analysis and ADP were 8.63 ± 4.08% and 8.01 ± 4.03%, respectively. Linear regression and Bland-Altman analyses indicated good agreement for %FM. The root mean square coefficient of variation (RMS-CV) for ADP was 17.9%, with a better precision in the higher fat mass range.

Useful Links

COSMED Homepage
http://www.cosmed.com

PEA POD Page
http://www.cosmed.com/peapod

COSMED
The Metabolic Company

CONCLUSIONS: Despite its relatively poor precision in the low range of %FM, ADP measures fat mass with reasonable precision and accuracy in the range of body weight encountered in low-birth-weight infants.

Body-composition assessment in infancy: air-displacement plethysmography compared with a reference 4-compartment model.

Ellis KJ, Yao M, Shypailo RJ, Urlando A, Wong WW, Heird WC. Am J Clin Nutr. 2007 Jan;85(1):90-5.

PURPOSE: A better understanding of the associations of early infant nutrition and growth with adult health requires accurate assessment of body composition in infancy. This study evaluated the performance of an infant-sized air-displacement plethysmograph (PEA POD Infant Body Composition System) for the measurement of body composition in infants.

METHODOLOGY: Healthy infants (n = 49; age: 1.7-23.0 wk; weight: 2.7-7.1 kg) were examined with the PEA POD system. Reference values for percentage body fat (%BF) were obtained from a 4-compartment (4-C) body-composition model, which was based on measurements of total body water, bone mineral content, and total body potassium.

RESULTS: Mean (+/- SD) reproducibility of %BF values obtained with the PEA POD system was 0.4 +/- 1.3%. Mean %BF obtained with the PEA POD system (16.9 +/- 6.5%) did not differ significantly from that obtained with the 4-C model (16.3 +/- 7.2%), and the regression between %BF for the 4-C model and that for the PEA POD system (R2 = 0.73, SEE = 3.7%BF) did not deviate significantly from the line of identity (y = x).

CONCLUSIONS: The PEA POD system provided a reliable, accurate, and immediate assessment of %BF in infants. Because of its ease of use, good precision, minimum safety concerns, and bedside accessibility, the PEA POD system is highly suitable for monitoring changes in body composition during infant growth in both the research and clinical settings.

Inter-device reliability of the PEA POD® for percent body fat estimates

MJ Yao, PA Roggero, P Piemontesi, W Lee, A Urlando. 2005 Life Measurement Inc./COSMED USA, Inc

METHODOLOGY: Inter-device reliability of the PEA POD was evaluated at two study sites: William Beaumont Hospital (WBH) in Royal Oak, MI, USA, and the Mangiagalli Clinic (MC) in Milan, Italy. Eight full-term infants were tested at WBH within 48 hours of delivery, and 12 infants (9 full-term and 3 pre-term, ≤ 1 mo of age) were tested at MC. At each site, duplicate body composition tests were performed in immediate succession on each subject using two PEA POD units located in the same testing room.

RESULTS: Percent body fat estimates by PEA POD units were highly correlated ($r > 0.96$, $P < 0.001$). There was no significant difference in mean %BF estimates (8.97 vs. 8.55 %BF) between the two PEA POD units.

CONCLUSIONS: Based on the inter-device reliability data obtained from two pairs of PEA POD units located at two study sites, it can be concluded that no significant difference in %BF estimates exists between PEA POD units, and the inter-device reliability of the PEA POD is excellent. Further, test-to-test reliability between PEA POD units is as good as within one unit.

Validation of a new pediatric air-displacement plethysmograph for assessing body composition in infants.

Ma G, Yao M, Liu Y, Lin A, Zou H, Urlando A, Wong WW, Nommsen-Rivers L, Dewey KG. Am J Clin Nutr. 2004 Apr;79(4):653-60.

PURPOSE: The accurate measurement of body composition is useful in assessments of infant growth and nutritional status. This study evaluated the reliability and accuracy of a new air-displacement plethysmography (ADP) system for body-composition assessment in infants.

METHODOLOGY: Between- and within-day reliability was assessed by comparing the percentage body fat (%BF) obtained on consecutive days and on the same day, respectively, in 36 full-term infants. Accuracy was assessed by comparing %BF measured with the use of ADP and %BF measured with the use of deuterium (2H2O) dilution in 53 infants.

RESULTS: There were no significant differences in %BF between days (-0.50 +/- 1.21%BF) or within days (0.16 +/- 1.44%BF). Mean between- and within-day test-retest SDs of 0.69 and 0.72%BF, respectively, indicated excellent reliability. The %BF measurements obtained by using ADP were not significantly influenced by infant behavioral state. Mean %BF obtained by using ADP (20.32%BF) did not differ significantly from that obtained by using 2H2O dilution (20.39%BF), and the regression line [%BF(2H2O) = 0.851%BF (ADP) + 3.094] gave a high R2 (0.76) and a low SEE (3.26). The 95% limits of agreement between ADP and 2H2O (-6.84%BF, 6.71%BF) were narrower than those reported for other body-composition techniques used in infants. Individual differences between the 2 methods were not a function of body mass or fatness.

CONCLUSION: ADP is a reliable and accurate instrument for determining %BF in infants, and it has the potential for use in both research and clinical settings.

A new air displacement plethysmograph for the measurement of body composition in infants.

Urlando A, Dempster P, Aitkens S. Pediatr Res. 2003 Mar;53(3):486-92.

PURPOSE: This article introduces and evaluates the PEA POD Infant Body Composition System, an air displacement plethysmograph designed for the assessment of body composition in infants between birth and 6 mo of age.

METHODOLOGY: The performance of the PEA POD was evaluated by repeated testing of National Institute of Standards and Technology-traceable weights and volumes. Mass was measured in a single session. Volume was measured in four sessions during a 2-d period (five times/session for both).

RESULTS: The mean values for repeated mass measurements were almost identical to the masses of traceable weights. The SD and CV for repeated volume measurements were 1.1-4.5 mL and 0.02-0.09%, respectively. Both the mean SD and CV were within very narrow ranges (1.4-3.1 mL for SD and 0.03-0.08% for CV) across all volume levels. Furthermore, mean CV values using results from the four sessions indicated excellent within- and between-day reliability. Regression analyses (by session or with all sessions combined) of the measured volume against actual volume gave very low standard error of the estimate (SEE) (0.853-1.957 mL) and very high R(2) (1.000), with the intercept and slope not significantly different from 0 and 1, respectively. The mean percentage error in volume measurements was < or =0.05% at all volume levels.

CONCLUSIONS: The study findings and the operational and physical characteristics of the system indicate that the PEA POD has the potential to provide clinicians and researchers with a diagnostic and research tool that is accurate, easily used by operators, and comfortable for subjects.

Evaluation of a new pediatric air-displacement plethysmograph for body-composition assessment by means of chemical analysis of bovine tissue phantoms.

Sainz RD, Urlando A. Am J Clin Nutr. 2003 Feb;77(2):364-70.

PURPOSE: Body-composition assessment reflects infant growth and nutritional status but is limited by practical considerations, accuracy, and safety. This study evaluated the precision and accuracy of a new air-displacement plethysmography (ADP) system for pediatric body-composition assessment.

METHODOLOGY: We used 24 phantoms constructed from bovine lean muscle and fat. The phantoms varied in mass (1.3894-9.9516 kg) and percentage fat (%Fat; 2.08-34.40%), thereby representing infants between birth and 6 mo of age. Estimates of %Fat obtained with chemical analysis (CA), hydrostatic weighing, and ADP were compared.

RESULTS: There was no significant difference between %Fat measured with ADP (%Fat(ADP)) and %Fat measured with CA (%Fat(CA)); the mean values were 18.55% and 18.59%, respectively. SDs for %Fat(ADP) and %Fat(CA) were not significantly different (0.70% and 0.73%, respectively). %Fat measurements obtained with ADP, CA, and hydrostatic weighing were highly correlated ($r > 0.99$, $P < 0.0001$). The regression equation (%Fat(CA) = 0.996%Fat(ADP) + 0.119; SEE = 0.600; adjusted R(2) = 0.997; $P < 0.0001$) did not differ significantly from the line of identity (%Fat(CA) = %Fat(ADP)). There was high agreement between individual measurements of %Fat(ADP) and %Fat(CA), as shown by the narrow 95% limits of agreements between methods (-1.22% to 1.13%), and there was no systematic bias in individual differences across the phantom mass and %Fat ranges.

CONCLUSIONS: ADP provides a highly precise and accurate estimate of %Fat in bovine tissue phantoms in the pediatric ranges of body weight and body fatness.

Preliminary evaluation of a new pediatric air displacement plethysmograph for body composition assessment in infants.

Yao M, Nommsen-Rivers L, Dewey K, Urlando A. Acta Diabetol. 2003 Oct;40 Suppl 1:S55-8.

PURPOSE: A preliminary evaluation of a new air displacement plethysmography (ADP) system for body composition assessment in infants was performed on 17 subjects on 2 consecutive days.

RESULTS: Mean (+/-SD) percent body fat (%BF) obtained from test 1 on day 1, and tests 1 and 2 on day 2 was 23.21+/-7.63, 22.94+/-7.50, and 22.55+/-7.61, respectively. Mean differences in %BF of within- (-0.39+/-0.81) and between-day tests (-0.27+/-0.97) did not significantly differ from zero. %BF 95% limits of agreements were very close (-2.0-1.2, and -2.2-1.7 for within- and between-day tests, respectively). %BF SDs (0.52 and 0.60 %BF for within- and between-day reliability, respectively) were not a function of the subject's behavioral state, body weight, or %BF.

CONCLUSIONS: Mean %BF obtained from the 3 tests (22.90+/-7.56) was comparable with expected %BF values calculated using data from multi-compartment studies (25.84+/-8.39 and 21.93+/-4.46).

Literature Reviews

Air Displacement Plethysmography: Cradle to Grave.

Fields DA, Gunatilake R, Kalaitzoglou E. Nutr Clin Pract. 2015 Mar 11. pii: 0884533615572443. [Epub ahead of print]

PURPOSE: Differences in body composition are associated with increased disease risk in various stages of life. Despite numerous available methods in assessing body composition (air displacement plethysmography, dual-energy X-ray absorptiometry, bioelectrical impedance, hydrometry, and magnetic resonance imaging), due to innate technical limitations, the ability for one singular method to track body composition over the life span (ie, infancy to adulthood) is challenging and imperfect. The primary goal of this review is to determine if there are body composition methods that can accurately track body composition from infancy into adulthood.

CONCLUSIONS: After careful consideration and taking into account the best available scientific evidence, we feel air displacement plethysmography is the best instrument at this time for tracking body composition, starting in infancy and forward into adulthood, partly because it is the only "practical" clinical tool currently available for use during infancy.

CONCLUSION: The core clinical measurements of weight, height, BMI and circumferences are sufficient to enable diagnosis of paediatric overweight and obesity while more technical tools provide further insight.

Infant body composition in the PEA POD® era: what have we learned and where do we go from here?

Li C, McCargar LJ2, Casey LM1. J Dev Orig Health Dis. 2013 Apr;4(2):116-20. doi: 10.1017/ S2040174412000657.

PURPOSE: The availability of clinically feasible infant body composition assessment can inform current questions regarding the developmental origins of chronic disease. A strategic approach will facilitate more rapid advancement in knowledge. The objective of this study was to summarize published evidence and ongoing research activity in infant body composition using the PEA POD® infant body composition system.

METHODOLOGY: All published studies using the PEA POD® were identified and grouped according to study population and question. All centers with PEA POD® units were invited to participate in an online survey regarding past, current and future PEA POD® use, and results were analyzed using descriptive statistics. The resulting information was used to identify gaps or limitations in existing knowledge, thus highlighting potential research priorities. Twenty-seven published articles were identified and grouped into six research themes. Although the number of infants studied is significant in some areas, interpretation of data is limited by methodological differences.

RESULTS: Survey responses were received from 16 of 60 centers. Research themes echoed those identified from the published literature.

CONCLUSIONS: Controlling for or reporting potential confounding variables is essential for understanding infant body composition data. Measurement of health outcome variables would be helpful in identifying associations.