Received: 6 March 2023 | Accepted: 10 March 2023

DOI: 10.1111/apa.16754

ACTA PÆDIATRICA NURTURING THE CHILD WILEY

COMMENTARY

EBNEO commentary: Fluid balance as a critical factor in neonatal outcomes

Brianna M. Liberio | **Rebecca S. Rose**

Department of Pediatrics, Division of Neonatal-Perinatal Medicine, Indiana University School of Medicine, Indianapolis, Indiana, USA

Correspondence
Brianna M. Liberio, Department of Pediatrics, Division of Neonatal-Perinatal Medicine, Indiana University School of Medicine, Indianapolis, IN, USA.
Email: bliberio@iu.edu

With this study, Starr and colleagues add to the growing body of literature recognising the importance of fluid status in neonates.[1–3] Utilising the weight-change method for estimating fluid balance, which is the preferred method in neonates,[4] they found that fluid balance is independently associated with the need for mechanical ventilation at post-natal day 14 and the composite outcome of severe bronchopulmonary dysplasia (BPD) or death.

All neonates undergo a period of adaptation of fluid and electrolyte homeostasis after birth, with a contraction of the extracellular fluid (ECF) compartment, driven by natriuretic diuresis and transepidermal losses in preterm infants. This phase ends with maximum weight loss or negative fluid balance.[5] Very low birth weight and extremely low birth weight infants can experience 10%–15% negative fluid balance, with this phase lasting up to 8 days.[5,6] Clinicians should allow for ECF contraction while maintaining intravascular fluid volume, achieving a negative sodium balance, maintaining normal serum electrolyte levels and providing sufficient calories to meet maintenance needs.[5,6] Achieving this requires close monitoring of daily intake and output, weight changes and electrolyte concentrations, while thoughtfully adjusting prescribed fluid intake.

In the same patient cohort as the present study, Valentine and colleagues analysed weight loss and fluid administration.[7] They found that a maximum weight loss of 5–15% within the first post-natal week was associated with decreased odds of developing necrotising enterocolitis (NEC), while an average total fluid administration of >150 mL/kg BW/day over the first post-natal week was associated with increased risk of NEC and patent ductus arteriosus (PDA) requiring surgery. They suggested cautious limitation of total fluid administration and allowing for moderate weight loss in the first post-natal week.[7] A 2014 Cochrane review recommended careful restriction of fluid intake in preterm neonates to meet physiological needs without causing dehydration rather than a practice of liberal fluid intake, citing that restricted fluid intake significantly reduced the risks of PDA and NEC, with trends towards reduced risk of BPD, intra-ventricular haemorrhage and death.[8]

No discussion about fluid status is complete without addressing electrolytes, specifically sodium. Dysnatremias are common in critically ill patients and are associated with mortality and hospital length of stay.[9] Preterm infants are at particular risk for dysnatremias given immature renal tubules, fluid shifts, insensible losses and exposure to parenteral nutrition. In an analysis of a contemporary large neonatal cohort, dysnatremias were common in the first week of life, occurring in half of the cohort.[9] In adjusted models, the occurrence of hypernatremia and combined hypo- and hypernatremia in the first week of life was associated with an increased risk of mortality in neonates with normal renal function.[9]

Weight changes, fluid intake, electrolyte status—this is quite the fine balance. When does physiologic weight loss become pathologic? Clearly, there are many variables and outcomes to consider. Starr and colleagues provide potential targets for this complex problem. In efforts to reduce rates of BPD and other neonatal morbidities, fluid balance is emerging as a critical factor.

URL LINK: https://ebneo.org/ebneo-commentary-fluid-balance-and-neonatal-outcomes/

Abbreviations: BPD, bronchopulmonary dysplasia; BW, birthweight; ECF, extracellular fluid; kg, kilogram; mL, milliliter; NEC, necrotising enterocolitis; PDA, patent ductus arteriosus.

EBNEO commentaries on manuscripts relevant to evidence-based neonatal practice are welcomed and published after a formal peer-review process. To learn more, visit https://ebneo.org/author-instructions/ and contact Dr. Amy Keir amy.keir@adelaide.edu.au or Dr. Clyde J. Wright clyde.wright@cuanschutz.edu with questions.

Related article: Starr MC, Griffin R, Gist KM, et al. Neonatal Kidney Collaborative Research Committee. Association of fluid balance with short- and long-term respiratory outcomes in extremely premature neonates. A secondary analysis of a randomised clinical trial. *JAMA Netw Open*. 2022; 5: e2248826. PMID 36580332.

FUNDING INFORMATION

None.

CONFLICT OF INTEREST STATEMENT

None.

ORCID

Brianna M. Liberio https://orcid.org/0000-0003-1085-7019

REFERENCES

1. Starr MC, Griffin R, Gist KM, et al. Association of fluid balance with short- and long-term respiratory outcomes in extremely premature neonates. A secondary analysis of a randomized clinical trial. JAMA Netw Open. 2022;5:e2248826.
2. Selewski DT, Gist KM, Nathan AT, et al. Neonatal kidney collaborative. The impact of fluid balance on outcomes in premature neonates: a report from the AWAKEN study group. Pediatr Res. 2020;87:550-557.
3. Selewski DT, Akcan-Arikan A, Bonachea EM, et al. Neonatal kidney collaborative. The impact of fluid balance on outcomes in critically ill near-term/term neonates: a report from the AWAKEN study group. Pediatr Res. 2019;85:79-85.
4. Goldstein SL, Akcan-Arikan A, Alobaidi R, et al. Pediatric ADQI Collaborative. Consensus-based recommendations on priority activities to address acute kidney injury in children: a modified Delphi consensus Statement. JAMA Netw Open. 2022;1(5):e2229442.
5. Fusch C, Jochum F. Water, sodium, potassium and chloride. In: Koletzko B, Poindexter B, Uauy R, eds. Nutritional Care of Preterm Infants: Scientific Basis and Practical Guidelines. Vol 110. Karger; 2014:99-120.
6. Oh W. Body composition in the fetus and newborn: effects of intrauterine growth aberration. In: Oh W, Baum M, eds. Neonatal Questions and Controversies: Nephrology and Fluid/Electrolyte Physiology. 3rd ed. Elsevier; 2019:19-28.
7. Valentine GC, Perez KM, Wood TR, et al. Postnatal maximal weight loss, fluid administration, and outcomes in extremely preterm newborns. J Perinatol. 2022;42:1008-1016.
8. Bell EF, Acarregui MJ. Restricted versus liberal water intake for preventing morbidity and mortality in preterm infants. Cochrane Database Syst Rev. 2014;2014:CD000503.
9. Basalely AM, Griffin R, Gist KM, et al. Association of early dysnatremia with mortality in the neonatal intensive care unit: results from the AWAKEN study. J Perinatol. 2022;42:1353-1360.

How to cite this article: Liberio BM, Rose RS. EBNEO commentary: Fluid balance as a critical factor in neonatal outcomes. Acta Paediatr. 2023;00:1–2. https://doi.org/10.1111/apa.16754