Does Sleep Physiology Predict Language and Literacy Development in Early Childhood?

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Introduction

- Sleep undergoes major changes during development, particularly between 0-5 years.[1]
- N3 supports memory consolidation,[2] but links to language and literacy in children have not yet been investigated.
- Language and literacy develop during early childhood, shaped by both caregiver-driven routines (e.g., reading to the child) and child-driven routines (e.g., initiating reading engagement).[3]
- Here, we examined whether sleep physiology was predictive of language and literacy development during early childhood.
- We hypothesized that N3 would be positively associated with reading time and book engagement, reflecting the cognitive development needed to participate in early language and literacy activities including learning and memory consolidation.

Methodology

- Children aged 3–5 years (Mage = 3.71, SD = 0.65, N = 39) participated in a larger study examining sleep and cognitive development.
- Parents reported children's home language and literacy activities (HLLA) via a brief questionnaire (19 items).
- Overnight sleep physiology was assessed via a 14-electrode ambulatory polysomnography system or a 32-channel polysomnography cap.
- PSG data was scored by trained technicians according to AASM criteria.
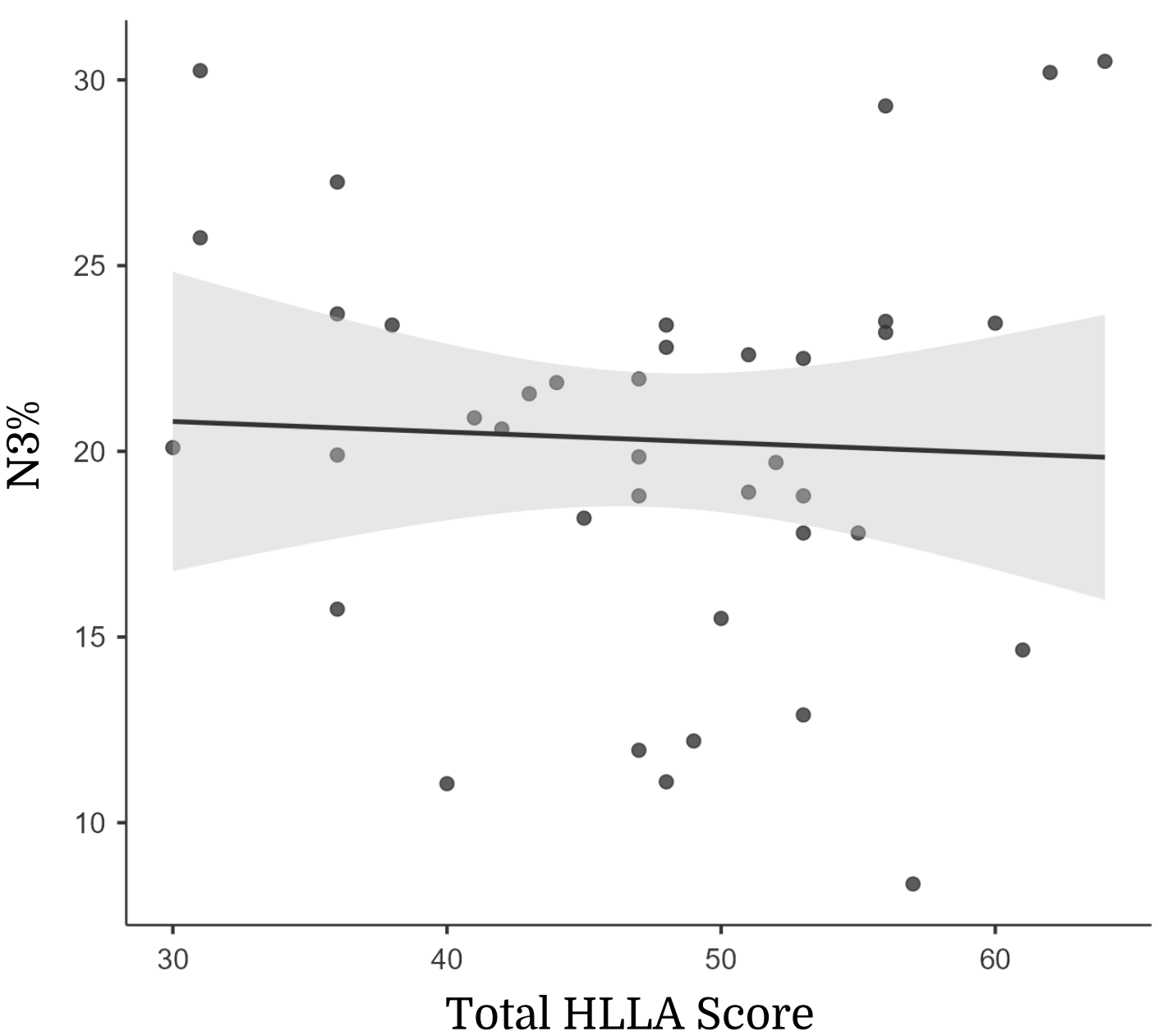
Results

### Home Language and Literacy Activities (HLLA) Summary
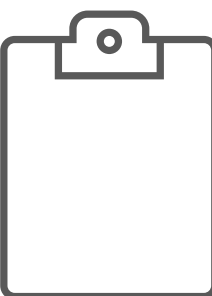
Measure	Range	Average Value	SD
Hours per week someone reads to the child at home	0-10	3.76	2.64
Child-initiated reading engagement	0-8	6.18	2.04
Caregiver-initiated language & literacy behaviors	0-24	14.67	5.19
Frequency of family literacy behaviors	0-16	8.13	3.59
Importance of school readiness benchmarks (caregiver beliefs)	1-20	18.54	2.37
Total HLLA Score	Min = 4, Max = 78	47.51	8.88

Sleep Physiology Summary
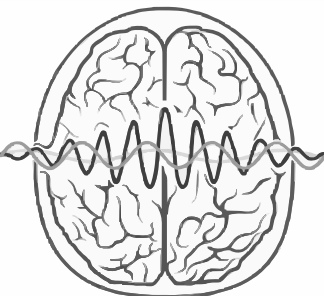
Sleep Stage	Time (min)	SD	% of Sleep Period	SD
TST	471.78	117.37	-	-
N1	11.95	6.57	2.41	1.35
N2	245.68	73.95	47.62	9.93
N3	101.49	27.62	20.31	5.49
REM	112.65	55.52	21.23	8.73
Wake	102.44	89.62	8.42	10.94

Does N3 sleep predict engagement in language & literacy activities?

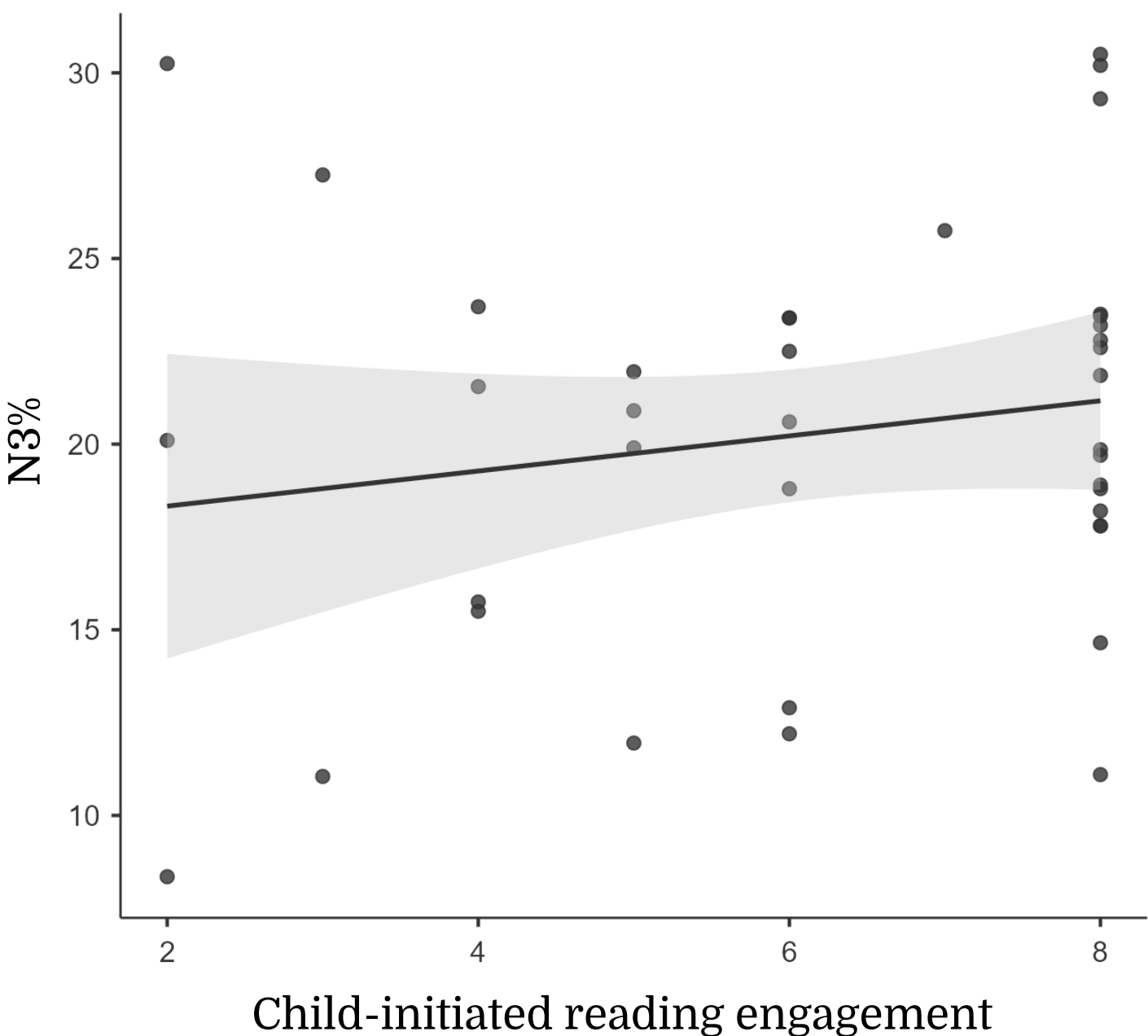The overall HLLA total score was not associated with N3 (r(39) = -.05, p = .78).

Does N3 sleep predict time spent reading to the child?
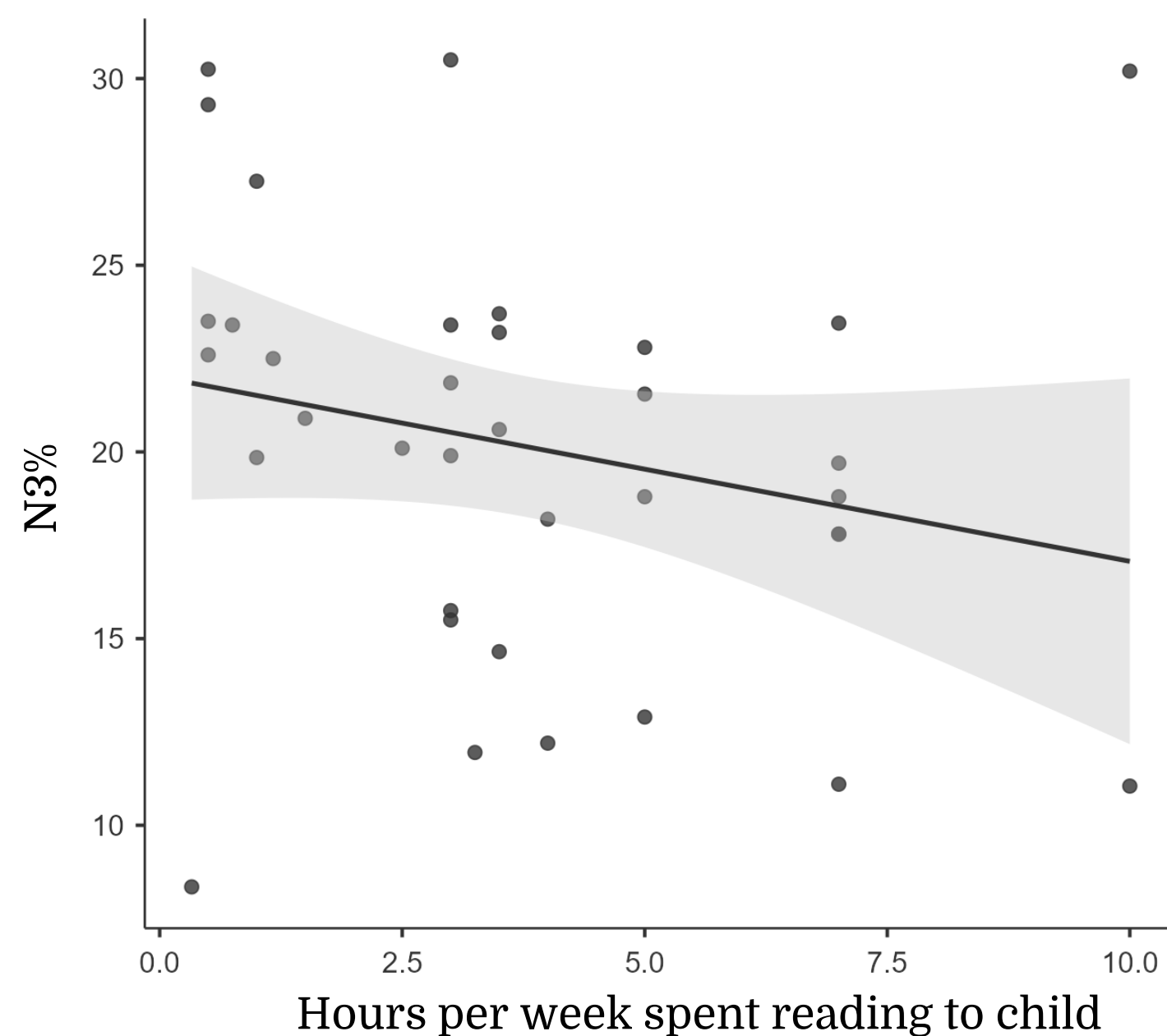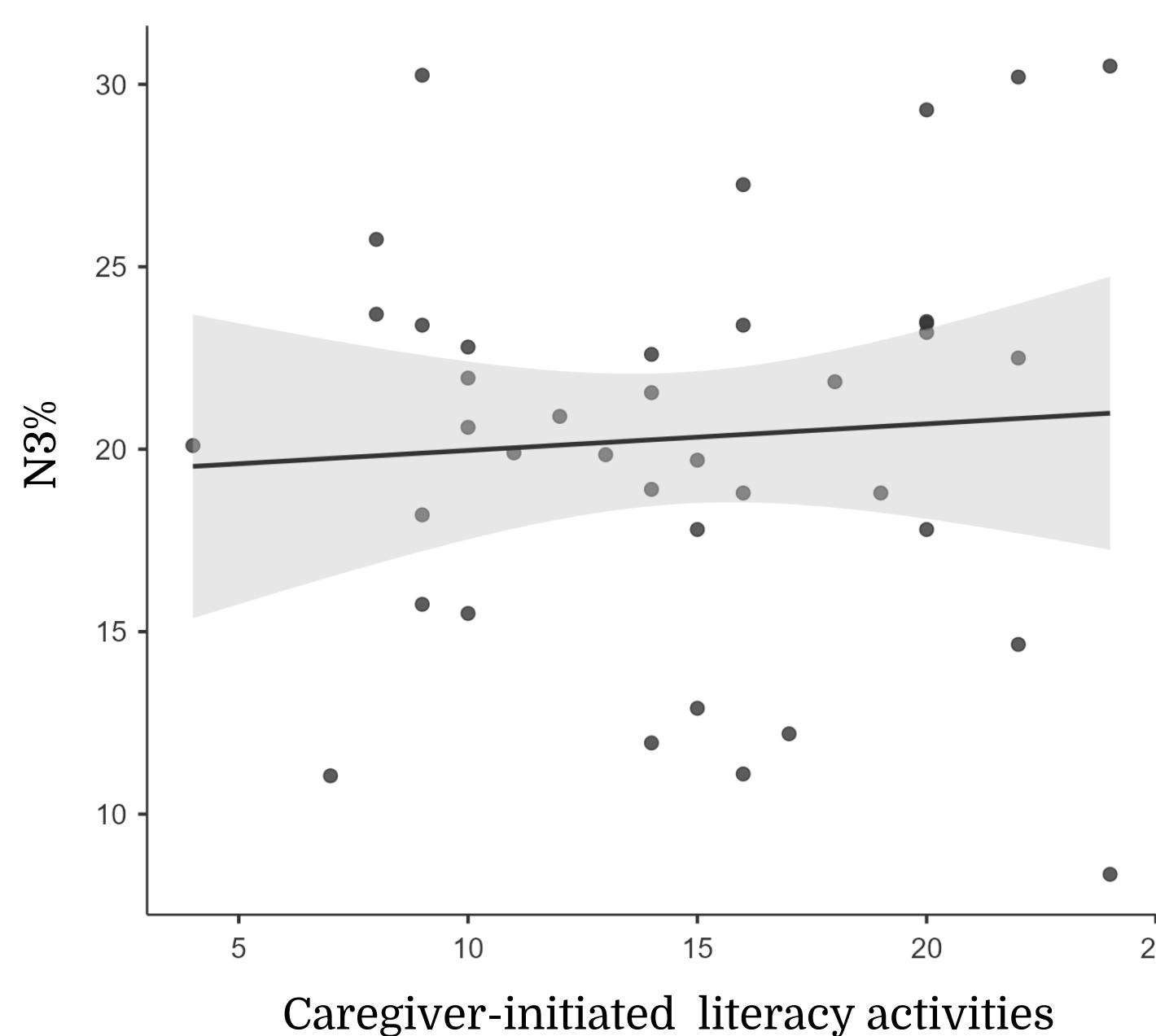

Hours per week spent reading to the child was not associated with N3 (r(36) = -.23, p = .18).

Does N3 sleep predict child-initiated reading engagement?

Child-initiated book & reading engagement was not associated with N3 (r(39) = 0.18, p = .29).

Does N3 sleep predict caregiver-initiated engagement in literacy activities?

Caregiver-initiated language and literacy activities were not associated with N3 (r(39) = .07, p = .68).

Conclusion

- Preliminary findings indicate that overall language and literacy (HLLA Total Score) was not associated with N3 sleep, potentially indicating that broad language input may not directly influence deeper sleep stages.
- Hours spent reading to the child was not significantly associated with N3. While reading before bed may support positive bedtime routines, our findings suggest it is not linked to subsequent sleep macrostructure.
- Child-initiated book engagement was not significantly associated with N3. Although this behavior may reflect a child's developmental readiness to engage with learning materials, this pattern was not supported in the current data.
- Caregiver-initiated reading was not significantly associated with N3 sleep, possibly because these interactions do not always reflect the child's engagement or developmental readiness.
- These null results suggest that specific language and literacy behaviors may not be directly linked to sleep physiology in early development. Future research should explore how language, reading, and sleep may support each other in early life.

References

(1) R.M.C. Spencer, & T. Riggins, Contributions of memory and brain development to the bioregulation of naps and nap transitions in early childhood, Proc. Natl. Acad. Sci. U.S.A. 119 (44) e2123415119, https://doi.org/10.1073/pnas.2123415119 (2022).

(2) L. Kurdziel, K. Duclos, & R.M.C. Spencer, Sleep spindles in midday naps enhance learning in preschool children, Proc. Natl. Acad. Sci. U.S.A. 110 (43) 17267-17272, https://doi.org/10.1073/pnas.1306418110 (2013).

(3) Dionne, G., Touchette, E., Forget-Dubois, N., Petit, D., Tremblay, R. E., Montplaisir, J. Y., & Boivin, M. (2011). Associations between sleep-wake consolidation and language development in early childhood: a longitudinal twin study. Sleep, 34(8), 987–995. https://doi.org/10.5665/SLEEP.1148