



Relationship between scores on the Child Oral and Motor Proficiency Scale at 12 months and Non-Nutritive Sucking at 3 months

Morgan Hines BS, Alaina Martens MS, CCC-SLP, Emily Zimmerman PhD, CCC-SLP
Department of Communication Sciences and Disorders, Northeastern University



BACKGROUND

- Non-nutritive suck, or NNS, is a suck pattern characterized by the absence of nutrient delivery (Wolf, 1968) and is linked to many important clinical outcomes, such as growth, weight gain, maturation, state control and gastric motility (Abbasi et al, 2008; Pickler RH, Higgins KE, Crummette BD, 1993; Reynolds et. al, 2010; Fucile, Gisel, Lau, 2005).
- Recent work published from our lab showed that NNS changes significantly between 3 and 12 months and that these changes are likely due to neural maturation, anatomical differences and oromotor experiences (Martens A, Hines M, Zimmerman E, 2020).
- A study by Wolthuis-Stigter and colleagues (2017) showed that sucking, sampled at 42 to 50 weeks using the Neonatal Oral-Motor Assessment Scale, was associated with motor skills at age five—with the better the sucking skills, the better the motor skills.
- While this study provides evidence for a relationship between infant sucking and motor development, the **goal of the current study** was to assess the relationship between NNS measures at 3 months of age and scores on the Child Oral and Motor Proficiency Scale (ChOMPS) at 12 months of age.

We hypothesized that there would be a significant association between each NNS outcome at 3 months and each subsection of the ChOMPS at 12 months.

METHODS

Study Design

- Data for this study was attained from a larger study examining sucking, feeding, and vocal development in preterm and full-term infants at 3 and 12 months of age.
 - Exclusion criteria: born with congenital and chromosomal anomalies
- This study focused only on NNS measures in full-term infants at 3 months and scores on the ChOMPS at 12 months.

NNS Data Collection and Analyses

- Infants were offered our custom research pacifier, see Figure 1, for ~ 5 minutes
- The best two minutes of NNS were analyzed based on cycle count
- NNS signals were analyzed with ADInstruments LabChart software yielding the following dependent measures:
 - duration (sec)
 - frequency (Hz)
 - amplitude (cmH₂O)
 - bursts
 - cycles per burst
 - cycles

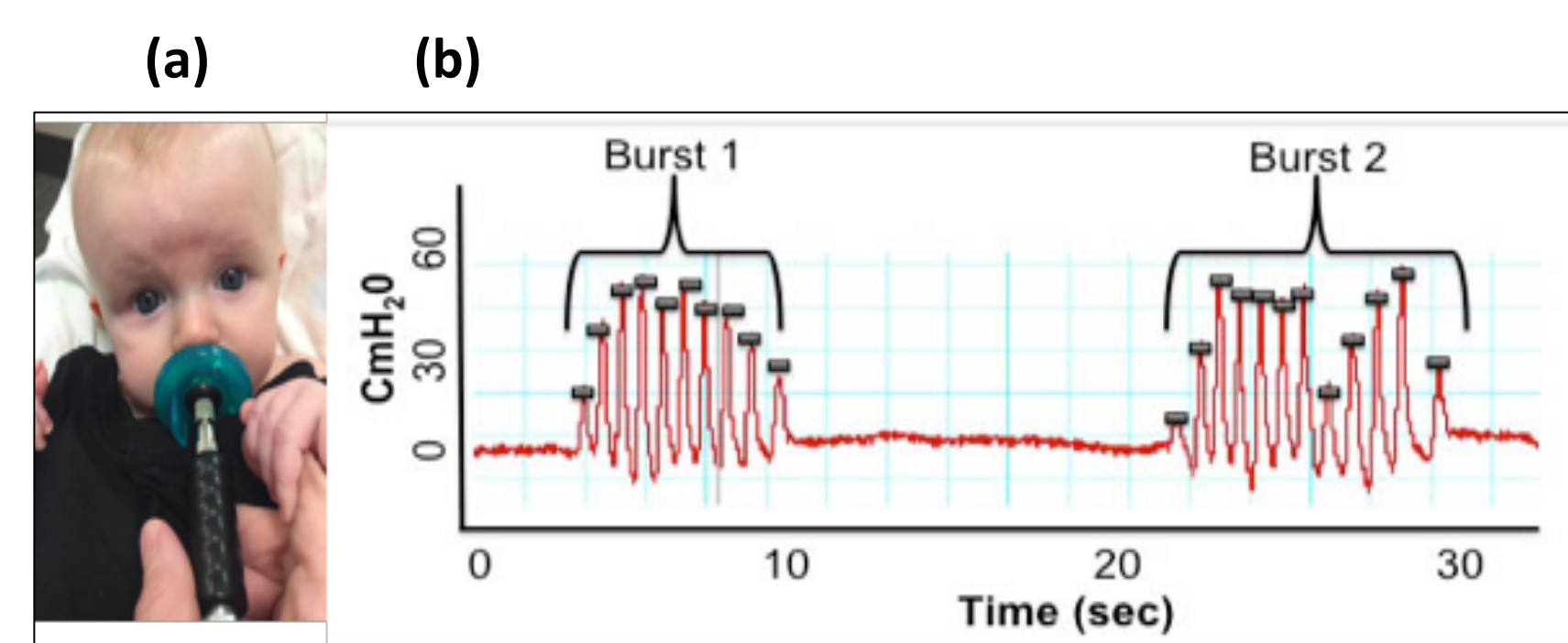


Figure 1: (a) Infant sucking on research pacifier during NNS collection (b) Example of 30s NNS sample with Burst 1 containing 10 cycles and Burst 2 with 12 cycles.

CHILD ORAL AND MOTOR PROFICIENCY SCALE (ChOMPS)

Directions: Below are a series of phrases that describe skills learned in early childhood. In this survey, we are interested in what your child can do, which may be different from what they are willing to do. When filling this out, think about what is typical for your child at this time. Your child may be too young to do some of the skills, and in that case, please check "Not Yet." If you are unsure if your child can do some of these skills because of restrictions placed on your child's eating (for example, they are not allowed to use spoons), then please check "Not Yet." If your child is older, he or she may have been doing these skills for a very long time and in that case, please check "Yes." This should take you about 15 minutes to complete. Take your time and talk to others who also care for your child, if needed.

My child can...	YES	SOMETIMES	NOT YET
1. stand without holding on to anything	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. walk 10-20 steps by himself/herself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. run 10-20 steps without falling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. walk up 2-3 stairs holding on to someone or something	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. walk up 2-3 stairs without holding on to someone or something	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. walk down 2-3 stairs holding on to someone or something	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. walk down 2-3 stairs without holding on to someone or something	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. jump with both feet without holding on to anything	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. drink from an open cup held by an adult when no or little spilling of liquid from mouth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. hold an open cup and drink by himself/herself with no or little spilling of liquid from mouth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. keep tongue in mouth when drinking from an open cup (held by self or an adult)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. drink from an open cup holding rim with lips (not biting rim with teeth)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. use a filled spoon or fork to bring food to mouth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. use scoop food onto a spoon or fork and bring to mouth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. use a fork to stab a piece of food and bring to mouth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. use tongue to lick food off of top lip	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 2: ChOMPS Complex Movement Patterns subscale.

PARTICIPANTS

- Sixty-nine infants (39 males) were enrolled in this study. These infants had an average birthweight of 3.45 kg (SD .45).
- Average age at testing at the 3-month visit was 2.99 (SD .28) months and 11.93 (SD .27) months at the 12-month time point.
- Maternal age at the 3-month study visit was 33.78 (SD 3.67), 97.10% of parents were married and 78.46% of parents had completed at least an undergraduate degree at the 3-month visit.

RESULTS

Spearman ranked correlations were used to examine all associations among the dependent variables.

Table 1 - Spearman correlations of NNS outcomes and ChOMPS domain and total scores

ChOMPS Higher Score is better function	Complex Movement Patterns "My child can stand without holding on to anything"	Basic Movement Patterns "My child can walk holding onto someone or something"	Oral-Motor Coordination "My child can move jaw up and down to chew"	Fundamental Oral- Motor Skills "My child can close lips completely"	ChOMPS Total Score
NNS Duration (seconds)	-0.208	-0.107	-0.291*	-0.158	-0.322**
NNS Frequency (Hz)	0.021	-0.048	0.178	-0.091	0.028
NNS Amplitude (cmH ₂ O)	0.044	-0.099	-0.151	0.004	-0.028
NNS Burst	-0.269*	-0.017	-0.218	-0.079	-0.275*
NNS Cycles/Burst	-0.213	-0.108	-0.237	-0.155	-0.310*
NNS Cycles/Minute	-0.268*	-0.059	-0.222	-0.102	-0.319**

Note: * p<.05, **p<.01, ***p<.001

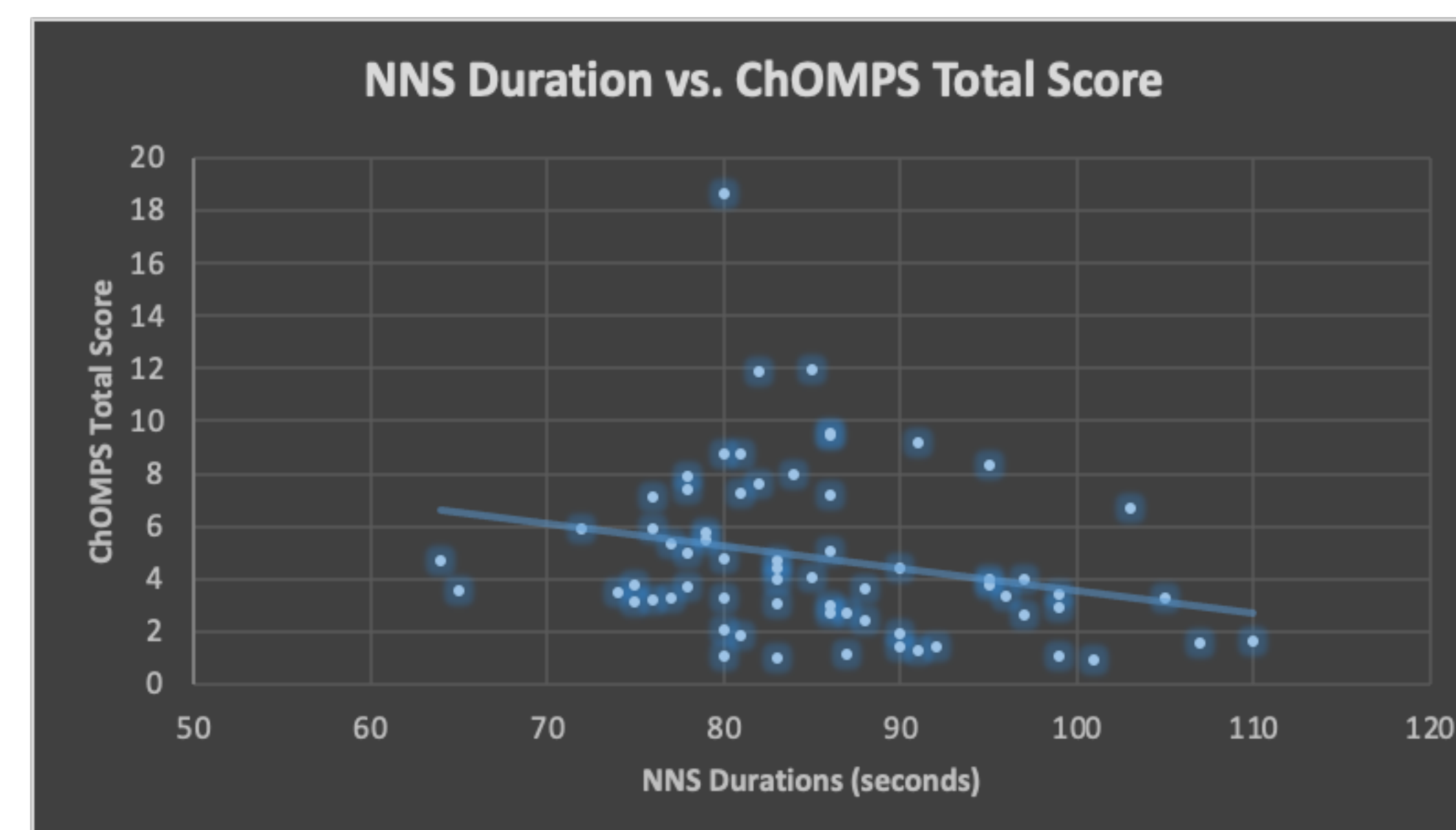


Figure 3: NNS Duration (seconds) vs. ChOMPS Total Score, $r = -0.322$, $p = 0.008$, indicating that shorter durations are related to higher ChOMPS Total Scores.

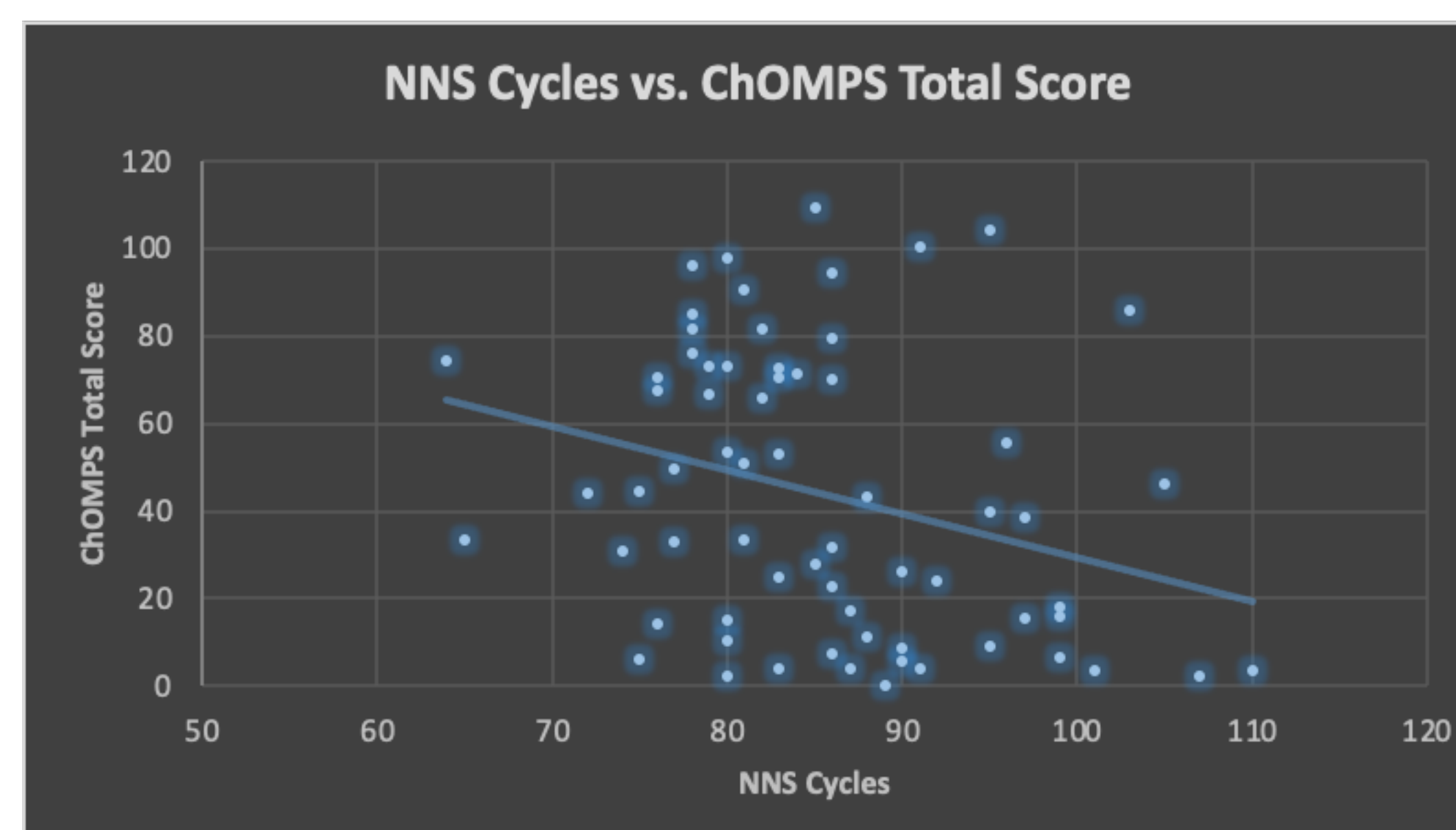


Figure 4: NNS Cycle count vs. ChOMPS Total Score, $r = -0.319$, $p = 0.009$. Data trends show that lower cycle counts are related to higher ChOMPS Total Scores.

DISCUSSION

There were significant associations for several NNS dependent variables at 3 months of age and ChOMPS subscale and total scores at 12 months of age.

NNS Duration

- Infants with shorter NNS Durations had higher scores on the ChOMPS Oral-Motor Coordination subsection and ChOMPS Total scores, indicating that a shorter NNS burst duration is associated with increased oral-motor skill and better overall oral and motor function.

NNS Bursts

- Infants with fewer NNS Bursts at 3 months had higher scores on the ChOMPS Complex Movement Patterns subsection and ChOMPS Total scores.
- These findings show that when infants have fewer NNS bursts during their suck sample, they have increased movement function and better overall oral and motor function at 12 months.

NNS Cycles per burst

- Infants with fewer NNS Cycles per burst had higher ChOMPS total scores, indicating better overall oral and motor function.

NNS Cycles

- Infants with fewer NNS Cycles per Minute had higher scores on the Complex Movement Patterns subscale and ChOMPS Total scores.
- These findings suggest that when infants have fewer NNS cycles during their suck sample, they have increased movement function and better overall oral and motor function at 12 months.
- Previous work suggests that as infants develop in the first year of life, their sucking becomes more succinct with shorter NNS durations and fewer cycles per burst and cycles per minute (Martens, Hines, Zimmerman 2020).
- Taken together with the results of the current study, these data indicate that infants who have more succinct NNS bursts, with fewer cycles, and fewer cycles per burst, and shorter durations at 3 months of age are more likely to have improved oral motor and overall all motor development at 12 months.
 - Could NNS sampled soon after birth be used to predict future motor outcomes?

NEXT STEPS

- Further investigation is needed to understand relationships between sucking and oral-motor and overall development.
- The recruitment of preterm and full-term infants for comparison across populations will continue in this on-going study.
- Future studies should focus on additional time-points (e.g., 18, 24, 30 months) to see how oro-motor and motor skills relate to suck throughout child development and should quantitatively measure motor skill development in addition to parent report.

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