Sleep, Cognitive Functioning, and β-amyloid in Adults with Down Syndrome

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INTRODUCTION

Individuals with Down syndrome (DS) have an increased prevalence of sleep disorders. Sleep disorders such as obstructive sleep apnea and behavioral sleep disturbances are associated with executive functioning and memory difficulties (Breslin et al., 2014) and have been linked to Alzheimer's disease (AD) in the general population (Chen et al., 2017). Individuals with DS have an increased risk for AD due to their third copy of chromosome 21, which contains the gene for the amyloid precursor protein. As a result of the triplication of this gene, individuals with DS have an overproduction of brain β-amyloid. The extent to which sleep disruptions are linked to executive functioning and memory in adults with DS, and may be associated with variability in AD onset and trajectory in the DS population is not known.

STUDY AIMS

1. Determine the feasibility of collecting sleep data via actigraph accelerometers in adults with DS
2. Evaluate the reliability and validity of sleep data via actigraph accelerometers in adults with DS
3. Examine the association between sleep and executive functioning and memory and a biomarker of early AD (β-amyloid).

METHOD

- Participants part of Neurodegeneration in Aging Down Syndrome (NiAD) project.
- **N=52** adults with DS (aged 26-56 years) were instructed to wear actigraph accelerometer wristband for 7-nights.
- Approximately half were male and half were female
- Participants, together with caregivers, also completed a daily sleep record.
- Prior to the daily diary, adults with DS were administered direct measures of executive functioning and memory, and underwent MRI and PET scans using the imaging agent [11C] Pittsburgh compound B (PiB) to assess β-amyloid in six areas in the neocortex.
- PPVT age equivalent (in years) mean and standard deviation: 7.91 (3.42)

ACKNOWLEDGEMENTS

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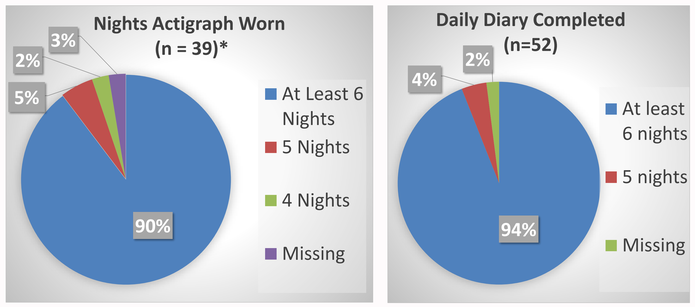
Charts 1. Percent of Participants Who Wore Actigraph and Completed Daily Diary



* Due to actigraphy charging issues during pilot testing, the first 13 participants were excluded from the feasibility analysis, therefore resulting in n=39.

TABLE 1. Correlations Between Actigraph and Diary Sleep Variables

	TST	SE	WASO	MI	FI	Length of Awakening
Calculated In Bed to Out of Bed	***r* = .668****	*r* = .125	*r* = .118	*r* = -.094	*r* = -.185	*r* = .040
Minutes Up	*r* = -.080	*r* = -.238	***r* = .299***	***r* = .294***	***r* = -.311***	*r* = .222
Number of Times Woke Up	*r* = .090	*r* = -.128	***r* = .273+**	*r* = .148	*r* = -.183	*r* = .205
Reported Total Sleep	***r* = .610****	*r* = .202	*r* = -.038	*r* = -.212	*r* = -.170	*r* = .096
Refreshed	*r* = -.135	***r* = -.278+**	***r* = .312***	***r* = .280+**	*r* = .062	*r* = .048

+ $p \leq .09$; *$p \leq .05$; ** $p < .01$

Figure 1. Association between Striatal β-Amyloid (PiB SUVR) and Average Length of Awakening

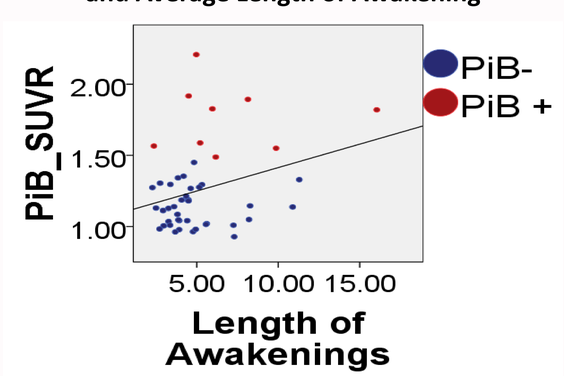


Table 2. Correlations Between Actigraph and Daily Diary with Cognitive Functioning (n=50)

		Cat/Dog Time	Digit Span FWD	Digit Span BWD	Free & Cued Recall	Delay Cued Intrusions	Consensus	Verbal Repetitions
Actigraph	TST	*r* = -.140	*r* = -.114	*r* = -.105	*r* = -.108	*r* = .048	*r* = -.163	*r* = .180
	SE	*r* = -.052	*r* = -.137	*r* = -.081	*r* = -.018	*r* = -.041	*r* = -.215	*r* = .235
	WASO	*r* = -.050	*r* = .151	*r* = .091	*r* = -.071	*r* = .123	*r* = .185	***r* = -.260†**
	Length of Awakening	***r* = .250†**	*r* = .083	*r* = -.015	*r* = -.028	*r* = .079	***r* = .329***	*r* = -.164
	MI	*r* = -.040	*r* = .073	*r* = -.117	*r* = -.086	*r* = .172	***r* = .323***	*r* = -.186
	FI	***r* = .347***	*r* = -.005	*r* = .193	*r* = .083	*r* = .038	*r* = -.068	*r* = -.231
Diary	Calc. In bed to out bed	*r* = -.131	*r* = -.024	*r* = .036	*r* = -.088	*r* = .101	*r* = -.116	*r* = -.007
	Mins Up	*r* = .032	*r* = -.166	***r* = -.298***	***r* = -.295***	***r* = .429****	***r* = .391****	*r* = -.112
	Number times woke up	*r* = -.081	*r* = .059	*r* = -.034	*r* = .147	*r* = -.009	*r* = .004	*r* = -.147
	Reported total sleep	*r* = -.054	*r* = -.048	*r* = .085	*r* = -.098	*r* = .083	*r* = -.083	*r* = .042
	Refreshed	*r* = -.010	*r* = .208	*r* = .117	*r* = .015	*r* = .036	*r* = .088	*r* = -.195

+$p \leq .09$; *$p \leq .05$; ** $p \leq .01$

SUMMARY OF RESULTS

- 90% of participants (n=39) wore the actigraph for at least 6 nights
- Actigraph indexes were correlated with reported sleep diary indexes in expected directions
- Length of awakenings and movement index were positively correlated with a measure of dementia status; individuals deemed to have mild cognitive impairment had a greater length of awakenings and more movement than those deemed to have no mild cognitive impairment or dementia
- Fragmentation index was associated with worse executive functioning
- Diary report of minutes awake at night was associated with worse executive functioning and episodic memory
- At a trend level, length of awakenings was associated with executive functioning and memory
- At a trend level, WASO was associated with intrusions to verbal episodic memory

IMPLICATIONS

- Actigraph sleep studies appear to be feasible in adults with Down syndrome and are associated with reported quantity and quality of sleep via sleep diaries.
- Sleep was associated with executive functioning and memory in adults with DS.
- Sleep was associated with mild cognitive impairment.
- Future studies should explore the association between sleep, cognitive functioning, and β-amyloid longitudinally.

REFERENCES

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