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Feasibility of Recording Sleep Quality And Sleep Duration Using Fitbit in Children with Asthma

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RATIONALE

Sleep disorders are common in children with asthma and are increasingly implicated in poor asthma control. Smart wearables such as the Fitbit wristband allow monitoring of users' sleep duration and quality in their natural surroundings. However, the utility and efficacy of using such wearable devices to monitor sleep in pediatric patients with asthma have not been well-established.

Thus, the objective of this study is to **demonstrate the feasibility of recording sleep quality and sleep duration using Fitbit in children with asthma.**
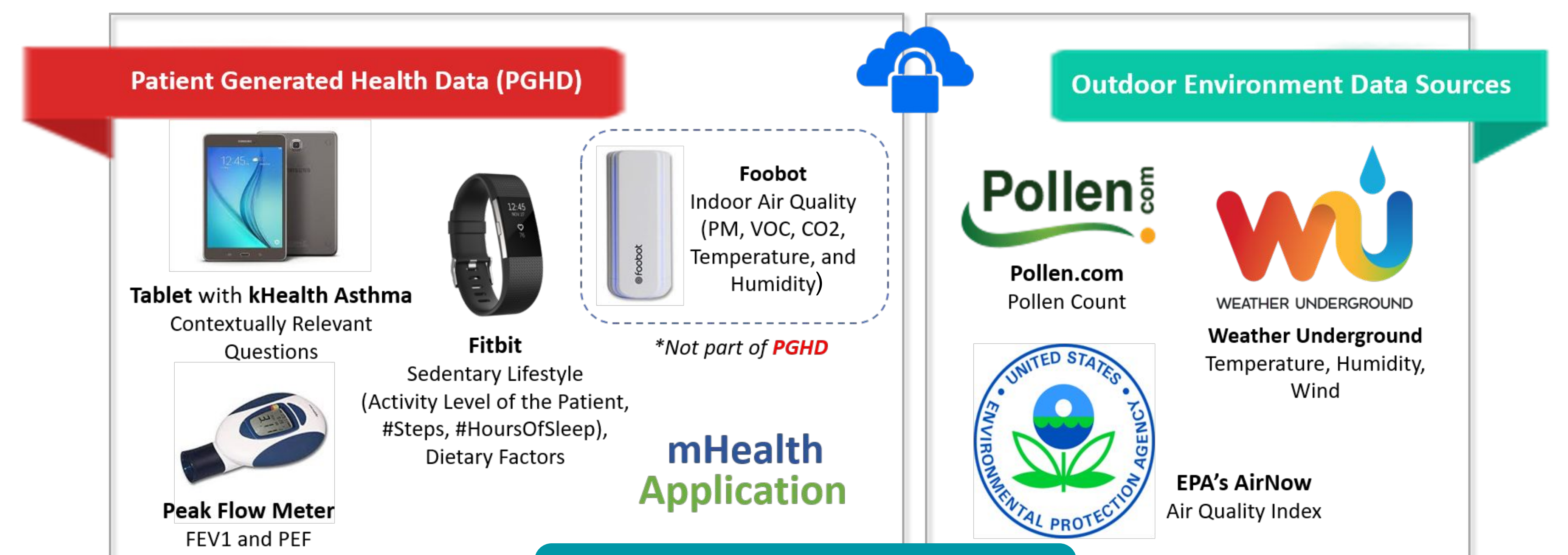

Figure 1: kHealth Kit

METHODS

34 children, ages 5 to 17 years, with varying levels of asthma severity (mild, moderate, and severe) were recruited from Dayton Children's Hospital for a period of **one month or three months** (Table 1). Each patient was provided with a kHealth kit (Figure 1) comprising of an Android tablet with a mobile health application that asks contextually relevant questions, a Bluetooth connected Fitbit Charge 2, Foobot (an indoor air quality monitor), and a peak flow meter. 29 different parameters were measured and 1862 data points were collected per patient per day. For this study, Fitbit software-calculated *time in bed*, *sleep time*, *time in REM sleep*, *light sleep*, and *deep sleep* data were downloaded from all subjects with an aggregated **total of 700 data points. Sleep efficiency** was calculated as *total sleep time over time in bed*. **The proportion of time in sleep stage** was calculated as *time in sleep stage over total sleep time*.

RESULTS

Table 1: Patient Demographics and Data Collection Frequency

Demographics	Number (n=34)
Mean Age in Years	12
Patients with Age 5 to 12, n (%)	19 (56%)
Patients with Age 12 and Above, n (%)	15 (44%)
Patients with Mild Persistent Asthma, n (%)	8 (24%)
Patients with Moderate Persistent Asthma, n (%)	17 (50%)
Patients with Severe Persistent Asthma, n (%)	9 (26%)
Average Number of Fitbit Readings Per Deployment	20 (67% Compliance)

Table 2: Sleep Characteristics by Age Group

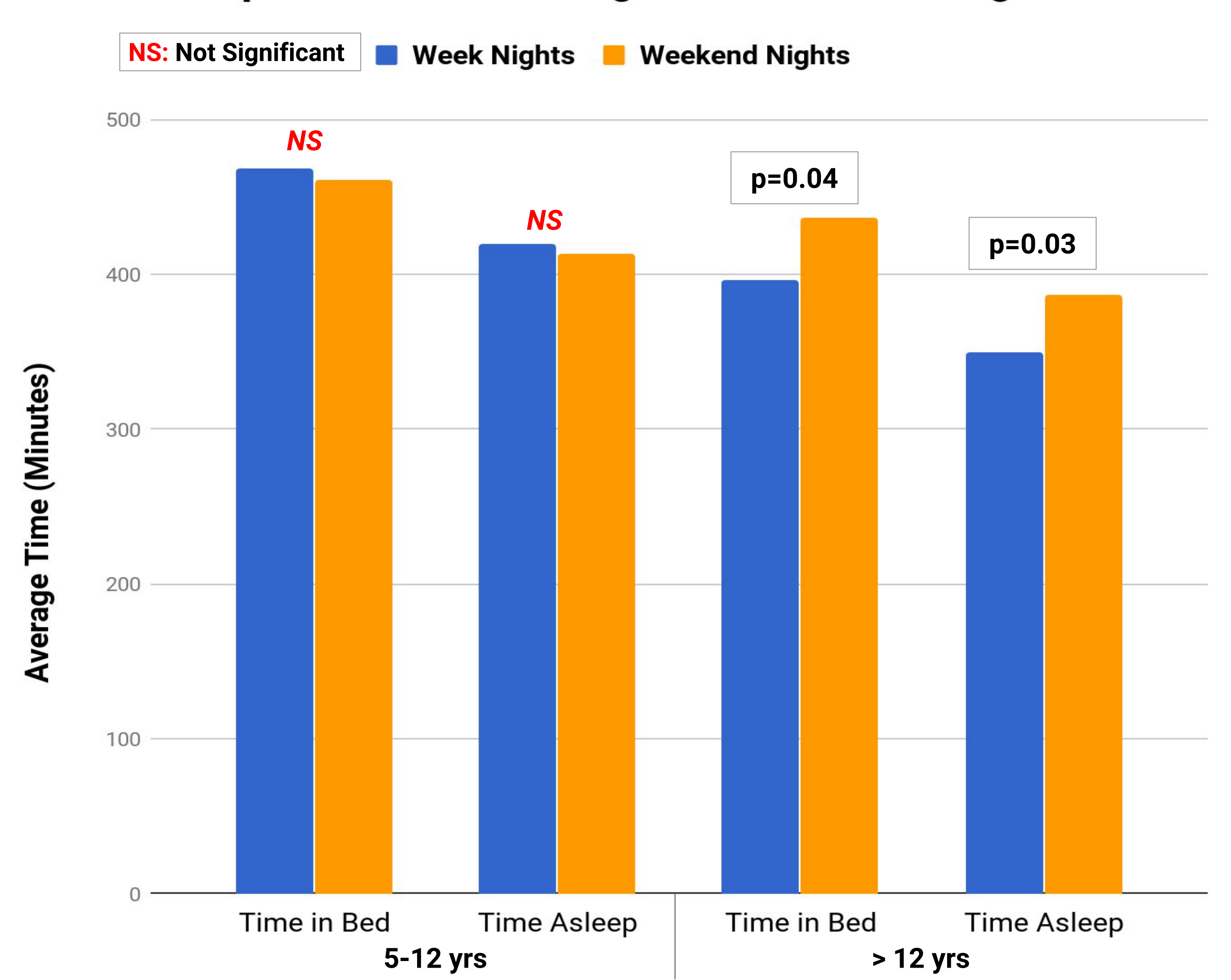| Sleep	Average Time (Minutes)		
	Age 5 to 12 (Pre-teens, n=19)	Age 13 to 17 (Teens, n=15)	All Patients (n=34)
Time in Bed	465.30	412.74	442.25
Sleep Time	417.25	364.44	394.09
REM Sleep	95.89	86.09	91.87
Light Sleep	247.90	247.53	247.75
Deep Sleep	89.00	78.30	84.61
Sleep Efficiency	90%	88%	89%

Figure: Teenagers spent a significantly higher time asleep on **weekends** as compared to **week nights**.

The Proportion of Sleep Time Spent: Deep Sleep 19.8%, REM Sleep 21.7%, Light Sleep 58.5%
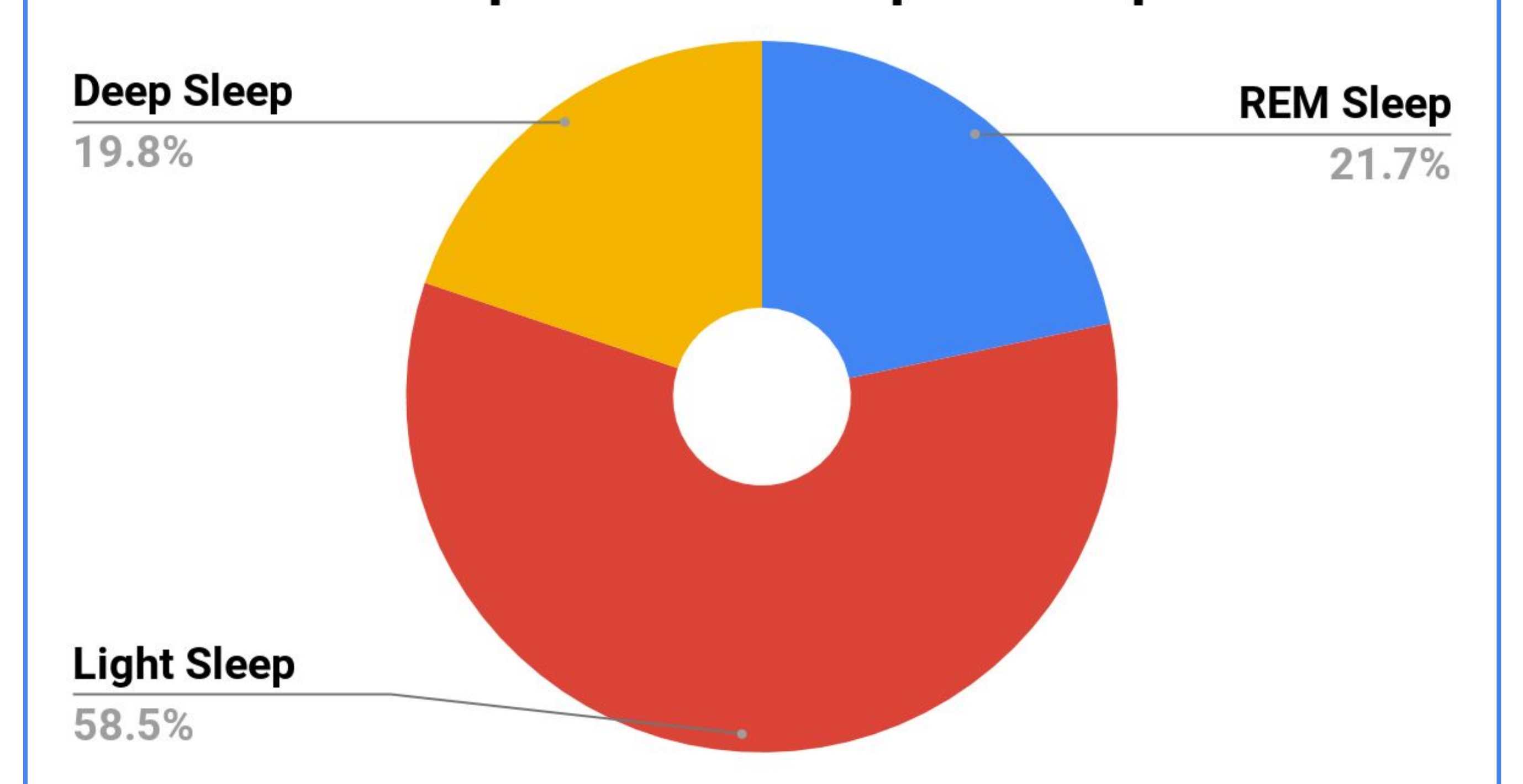
These results correlated well with polysomnography based normative data in children.

ACKNOWLEDGEMENT

CONCLUSION

Our findings **supported the potential use of wrist-worn devices** to **continuously monitor sleep duration and quality in children with asthma**. This should allow for better evaluation of the effect of sleep on asthma outcomes in children.