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A Preliminary Study of New Parents, Sleep Disruption, and Driving: A Population at Risk?

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Abstract

Background—Drowsy driving is estimated to be a causal factor in 2–16% of vehicular crashes. Several populations are reported to be at high risk for drowsy driving accidents, including shift workers, teenage drivers, medical residents, and pilots. Although new parents are known to have significant sleep disruption, no study has investigated vehicular accidents or near miss accidents in this population.

Methods—A preliminary cross-sectional, anonymous survey of parents who had given birth within the previous 12 months. Participants were asked about their sleep, including validated measures of sleep disruption, their driving patterns, and information about near miss traffic accidents and actual crashes.

Results—Overall, 72 participants were enrolled. A large proportion of participants had poor sleep including approximately 30% with daytime sleepiness, 60% with poor daytime function and two-thirds with poor sleep quality. The mean sleep duration was only 6.4 hours. Although most participants drove <100 miles per week, 22.2% reported at least one near miss accident and 5.6% reported a crash. Sleep problems were more common in those with near miss accidents and actual crashes than in those without. Of note, poor sleep quality was associated with a 6-fold increase in near miss accidents even after accounting for other factors.

Conclusion—Poor sleep is common in new parents and we provide preliminary evidence that sleep disruption in this population is associated with near miss motor vehicle accidents. Drowsy driving results in thousands of unnecessary serious injuries and fatalities each year; raising public awareness that new parents are a high-risk group is important.

Keywords

postpartum; infant; drowsy driving; near-miss, motor vehicle accident

Background

Drowsy driving, where a driver is considered drowsy, fatigued, sleepy, or asleep has long been considered contributory to motor vehicle accidents (MVAs). Using data from 2009, the National Highway Traffic Safety Administration (NHTSA) reported that an estimated 30,000 injury crashes were associated with documented drowsy driving, (approximately 2% of all injury crashes that year).¹ Furthermore, approximately 72,000 out of 5.5 million of all police-reported crashes for 2009 (including fatal, injury, and property damage) involved drowsy driving.

These figures are similar to data from 1989–1993 suggesting that driver fatigue and drowsiness were a factor in approximately 3.6% of fatal crashes during those 5 years.² Moreover, the National Motor Vehicle Crash Causation Survey of post-crash tow-away vehicles found that 3.2% involved a sleepy or actually-sleeping driver while 7% involved driver fatigue.³ However, the true proportion of MVAs that involved drowsy driving is unknown since there is no objective test for drowsy driving and it is likely highly under-reported by the individuals involved. In a recent analysis of over 47,000 crashes in the United States between 1999–2008, which found that approximately 45% of all crashes had no information regarding drowsy driving, use of statistical models suggested that 7% of all crashes, 13.1% of non-fatal crashes, and 16.5% of fatal crashes involved drowsy driving.⁴ These data suggest that the prevalence of fatal crashes that involve a drowsy driver may be up to 350% greater than has been reported previously.

There have been multiple studies on the impact of drowsy driving in populations such as truck drivers, pilots, shift workers, medical residents, teenage drivers, and other populations.^{5–11} Those who work long hours or have jobs that alter circadian rhythms report a high prevalence of drowsy driving and are at increased risk of MVAs and near-miss accidents (NMAs). One population that has not been previously studied is parents following the birth of a child. New parents often experience significant sleep disturbance due to infants' non-entrained sleep schedules and frequent nocturnal care requirements.^{12–15} Similar to persons with clinical sleep disorders, postpartum women are at increased risk of poor sleep quality, sleep fragmentation and restriction, as well as deficits in daytime neurobehavioral performance/fatigue.^{16–19} Despite a wealth of literature on the prevalence and consequences of drowsy driving no study has investigated a link between sleepiness in new parents following childbirth and road traffic accidents. This pilot study therefore aimed to determine whether there was preliminary evidence of a relationship between new parents and MVAs/NMAs.

METHODS

Participants

These data comprise a cross-sectional study, between February and October 2011, of parents who had given birth within the previous 12 months in a suburban area of the Midwest. All participants were attending well-child clinics. Each participant (one per family) was invited to complete a questionnaire about their sleep and that of their child. Demographic data were also obtained. The study was approved by the Institutional Review Board.

Data Collection

Parental sleep—Self-reported bed times and wake times were obtained and sleep duration was calculated. Short sleep duration was defined as self-reported sleep duration of 6 hours per night and long sleep duration was defined as self-reported sleep duration 10 hours per night.

Sleep quality and daytime function were assessed using the 21-item self-report General Sleep Disturbance Scale (GSDS).²⁰ Women were asked to provide the frequency of specific sleep complaints from 0 (not at all) to 7 (every day) and were asked to consider these complaints in general since their baby was born. The GSDS comprises several subscale domains including sleep quality and daytime function. Consistent with the Diagnostic and Statistical Manual of Mental Disorders criteria for insomnia, clinically significant sleep disturbance was identified by a mean domain score of 3 or more.

Sleepiness was measured by the Epworth Sleepiness Scale, an 8-item questionnaire that asks about the likelihood of falling asleep in variably sedentary situations such as driving a car or sitting and watching television in the course of daily life in “recent times”.²¹ This measure of subjective sleepiness, or sleep propensity, is reliable, internally consistent, and has been validated against objective polysomnographic measures.²¹ A score 10 suggests excessive sleepiness. In addition, women were asked: “Which of the following is the worst problem for you?” with response options being “sleepiness”, “fatigue”, “lack of energy” or “tiredness” and how often they felt this way (“rarely”, “occasionally”, “frequently”, almost always”).

The validated STOP questionnaire was used to determine a positive screen for OSA with a sensitivity of 79.5% for identifying severe obstructive sleep apnea.²² Women were also asked the frequency of snoring. Habitual snoring, as a marker of sleep-disordered breathing, was considered present if women reported snoring at least 3 nights per week in recent times since the birth of their baby.

Infant sleep—Information regarding infant sleep was obtained using the Brief Infant Sleep Questionnaire.²³ The BISQ has been validated against actigraphy and daily-logs and has sensitivity in documenting expected developmental changes in infant sleep as well as effects of environmental factors. The BISQ includes questions about infant daytime and nighttime sleep patterns and sleep-related behaviors.

Driving questionnaire—Participants were queried about the driving they had engaged in since the birth of their baby. This included the approximate number of miles were driven per week, frequency of driving for 30 minutes or an hour or more at a time, whether or not they had felt sleepy or drowsy while driving, and whether or not they had been involved in a NMA or a MVA while they were the driver. For those who reported NMAs, information was obtained on the number of NMAs, age of their child at the time of the NMAs, the duration of the index trip, approximately how many hours of wake time had occurred on the index day and how many hours of sleep time had occurred on the previous night. Participants were also asked to rate how drowsy they felt right before the NMA and whether other vehicles were involved. NMA were considered present if respondents indicated having

had to swerve or brake suddenly to avoid an accident since the birth of their child. Similar information was obtained for those who reported a MVA.

Drowsy drivers were defined as those respondents who endorsed the question “How often have you felt sleepy while driving?” by reporting at least a few times a month or more.

Other variables—Other variables captured on the questionnaire included parental age, race, parity, marital status, employment status, and whether employment involved shift work.

Statistics—All data obtained were double-entered into a database and analyzed with SPSS (version 19.0, IBM, Armonk, NY). Histograms, box-plots, and descriptive methods were used to examine data for errors and outliers. Mean $\pm$ standard deviation was used to report normally distributed data while median and range was used to report non-normally distributed data. Between-group comparisons of continuous variables were conducted with t-tests. Dichotomized variables were compared with Chi Square tests. Logistic regression was used to determine associations between NMAs and sleep variables after adjusting for potential covariates where appropriate. Odds ratios (OR) and 95% Confidence Intervals (CI) and effect sizes were calculated. Effect sizes were calculated for mean values using Cohen's d. Effects sizes were considered small if <0.1 , medium if $0.1-0.3$, and large if >0.5 . A p-value <0.05 was considered statistically significant.

RESULTS

In total, 74 new parents were enrolled; however two participants only completed demographic and driving information and did not complete the sleep surveys. These two were thus excluded from analysis. The final dataset comprised 72 participants. The vast majority ($n=66$; 92%) of participants completing the questionnaire were mothers and the rest were fathers. Overall 52.8% of infants were male. Demographics of the sample population are shown in Table 1.

The majority of infants (79.2%) slept in their parents' room. The median duration of nighttime sleep was 8.0 hours (range 2.0–13.0 hours) and the median duration of daytime sleep was 4.0 hours (range 0.3–10.8 hours). Night wakings occurred at a median of 2.0 per night (range 0.0–5.0) and the median duration of wakefulness during the night was 1.0 hours (range 0.0–5.0 hours)

Typical sleep patterns of new parents at the time of enrollment into the study are shown in Table 2. Overall, approximately 20% screened positive for OSA, 30% for daytime sleepiness, and 60% for poor daytime function. Two thirds reported poor sleep quality. The mean sleep duration was 6.4 ± 1.8 hours and nightshift workers reported significantly less sleep (5.4 ± 1.3 vs. 6.6 ± 1.8 , $p=0.01$, $d=0.70$) than non-nightshift workers.

Table 3 shows driving habits since having a baby. The majority (81.9%) of parents drove <100 miles per week and few (16.7%) had frequent journeys - at least 3 days/week - of at least 1 hour of driving. Overall, 18.1% of new parents reported driving while sleepy at least

once per week and 8.3% reported falling asleep while driving. None of the latter were nightshift workers.

Near-miss accidents

Near-miss accidents were reported by $n=16$ ($n=14$ mothers) which was 22.2% of the total sample. The number of NMAs per person ranged from 1–5. The median age of the infant at the time of the NMA was 18.5 weeks (range 4.0–48.0 weeks) with most NMAs ($n=13$ of 16) occurring when the infant was 6 months or younger. Over one third (37.5%) of NMA's occurred in nightshift workers. Overall, 56.3% of NMAs involved another vehicle and the remainder involved only the index vehicle. No-one was hurt in any NMA.

Of those who reported a NMA, the median driving time prior to the NMA was 22.5 minutes (range 5–90 minutes). Reported hours spent awake before the NMA was a median of 10.0 hours (range 2.0–31.0 hours). Reported sleep the night before the NMA was a median of 5.5 hours (range 0.0–8.0 hours). Seven parents (43.8%) reported feeling “very drowsy” or “moderately drowsy” just before the NMA and an additional 3 reported feeling “slightly drowsy”.

There were no differences in parental age or ESS between those who reported a NMA compared to those who did not; 28.6 ± 8.1 years vs. 27.1 ± 5.8 years, $p=0.49$ and 7.4 ± 3.6 vs. 6.3 ± 4.0 , $p=0.31$ respectively. Neither were there differences in the median age of the infant between those who reported NMA's versus those who did not (18.5 vs. 16.0 weeks, $p=0.72$). The mean number of infant night wakings was the same in each group (1.7 ± 1.3 vs. 2.2 ± 1.3 , $p=0.19$). However, those who reported a NMA had a higher mean sleep quality score (4.3 ± 1.5 vs. 3.4 ± 1.6 , $p=0.04$, $d=0.57$) and a higher daytime function score (4.3 ± 1.4 vs. 3.0 ± 1.6 , $p=0.005$, $d=0.83$), both indicative of worse quality and daytime function respectively, with large effect sizes. The proportion of parents with poor sleep quality among those who reported a NMA and those who did not have a NMA was higher although not statistically significant in this small sample (81.3% vs. 55.8%, $p=0.22$). Nonetheless, those who reported a NMA were significantly more likely to report poor daytime function compared to others (87.5% vs. 46.2%, $p=0.008$). There were no differences in NMA between married and single parents (32.4% vs. 16.7%, $p=0.25$), nor were there any differences in NMA between those who screened positive on the STOP questionnaire vs. those who did not 20.0% vs. 25.0%, $p=1.0$).

In a logistic regression model, after controlling for infant age at the time of the event, number of hours of parental sleep, marital status, STOP questionnaire, night shift, and typical weekly driving, poor sleep quality was independently associated with NMAs (O.R. 6.2, 95% CI 1.1–44.6; $p=0.04$). Of note, working night shift was also found to be independently associated with NMA (O.R 8.9, 95% CI 1.5–53.3, $p=0.03$).

Motor vehicle accidents

Motor vehicle accidents were reported by $n=4$ mothers (5.6% of the total sample). The median age of the infant at the time of the MVA was 39.5 weeks (32–48.0 weeks). All MVA's involved other vehicles although only one involved injuries.

Of those who reported a MVA, the median driving time prior to the MVA was 20.0 minutes (range 2–20 minutes). Reported hours spent awake before the MVA was a median of 8.0 hours (range 0.8–13.0 hours). Reported sleep the night before the MVA was a median of 6.0 hours (range 6.0–8.0 hours). Only one mother reported that she was “very drowsy” before the MVA; the others reported that they were “not at all drowsy”.

There were no differences in parental age or ESS between those who reported a MVA compared to those who did not; 33.5 ± 7.9 years vs. 27.4 ± 6.2 years, $p=0.22$ and 8.0 ± 2.4 vs. 6.7 ± 4.0 , $p=0.38$ respectively. Although there was a tendency for the median age of the infant to be greater in those who reported MVA's versus those who did not (39.5 vs. 16.0 weeks, $p=0.24$), this did not reach statistical significance in such a small group. The mean number of infant night wakings was the same in each group (1.0 ± 1.0 vs. 2.1 ± 1.3 , $p=0.18$). There were also no differences in mean sleep quality score (3.2 ± 1.7 vs. 3.6 ± 1.6 , $p=0.61$) or daytime function score (3.0 ± 1.9 vs. 3.3 ± 1.6 , $p=0.76$) between those who reported a MVA compared to those who did not in this small sample. The sample size was not large enough to conduct Chi-square analyses.

Discussion

This is the first study to report on drowsy driving in new parents. Our data demonstrate that sleep problems are common in new parents and that poor sleep quality and impaired daytime function in the postpartum period are associated with near miss vehicular accidents.

Previous reports have linked sleep disturbance with greater risk of MVAs in populations such as truck drivers, pilots, shift workers, medical residents, teenage drivers, and other populations^{5–11,24} but none of these studies have specifically targeted new parents. This is unfortunate since, as a group, they often reported frequent driving with almost 60% of our population spending over one hour each day behind the wheel. Our data supported the findings for shift workers even within this group of new parents.

New parents reporting an NMA had worse sleep quality and daytime function than those not reporting NMAs and also had short sleep duration, suggesting that sleep disturbance played a factor in their NMAs. Although MVAs were reported by $n=4$ study participants, this number was too small to make sufficiently powered comparisons. Near-miss accidents are more frequent than actual crashes and are dangerous precursors to actual driving accidents.²⁵ Near-misses are known to be highly correlated to sleepiness at the wheel and should be considered as strong warning signals for future accidents.²⁶ Larger studies are required to determine the correlation between sleep disturbance and MVA's, as well as the relationship between NMA's and risk for MVAs in this population.

A limitation of this study is recall bias. While it is unlikely that parents forgot about a MVA, it is possible that NMAs are under-reported. Further, with the methods employed it is not possible to know with certainty how sleepy parents were on a particular day, whether they accurately recalled the timing of the event, their sleep prior to the NMA/MVA, or how long they had been driving. Nonetheless it is very possible that our findings under-represent the true association between drowsy driving and NMA/MVA in the postpartum period.

Inherent in its design, this study was unable to capture any motor vehicle-related deaths or incapacitating injuries that would preclude a parent from attending a well-child visit. Other selection bias is inherent in anonymous surveys, such as this one. For example, parents who are extremely fatigued or occupied during a clinic visit may be less inclined to focus energy on completing a survey at the opportunity cost of tending to their infant in the waiting room. Other potential biases of our study include that 20% were nightshift workers. Shift workers tend to have greater sleep disturbance than the general population, which could account for some, but not all, of the sleep disturbance seen in the study population.

The study population was generally rural or suburban. It is well known that driving conditions may vary by geography; varied driving skill sets may be required in rural versus urban settings and in winter-weather versus year-round warm weather climates. While we did not obtain details of weather conditions at the time of the NMA or MVA, results from this study are likely to be more generalizable to rural-suburban areas hosting winter driving conditions for at least several months as opposed to an urban center with year-round sunny weather.

To our knowledge, this is the first study of its kind to evaluate the relationship among new parents, sleep disturbance, and risk for MVA's or NMA's. Our findings suggest that the sleep disturbance of new parenthood plays a role in reported NMA's during the first postpartum year. However, larger studies with more objective measures are required to determine the relationship between such sleep disturbance and risk for MVA's. Previously reported studies that have utilized police crash reports²⁷ could be useful if additional information is obtained on whether the driver had a new baby in the house. However, law enforcement do not receive any special training in the identification of crashes attributed to drowsy driving, nor are drivers themselves good judges of whether they were sleepy. Accidents in which drivers had fallen asleep may be easier to identify since they often involve a characteristic pattern without signs of braking or steering to avoid a collision.² Drowsy driving accidents are more problematic because there is no clear way to attribute an accident to being drowsy.

Such larger studies may also be used to identify sensitive and specific predictors of drowsy driving-associated NMAs and MVAs. Ideally, such studies would incorporate rural to urban driving conditions as well as multiple geographic climates. Such studies could lay the groundwork to screen new parents for high-risk predictors of MVAs and determine which parents may benefit from more specific interventional strategies such as counseling, education, or sleep deprivation countermeasures aimed at preventing MVAs.

Our study population demonstrated several findings that have been previously shown to increase a driver's risk of a sleep-related MVA. These include working night shift, averaging around 6 hours of sleep per night, poor quality sleep, and having a high risk of obstructive sleep apnea.²⁷ While we cannot determine whether these factors were present before the birth of the baby, it is well known that new parents have poor sleep quality and reduced sleep duration.¹³¹⁶¹⁷

In summary, we suggest that new parents are a group of individuals that are at high risk of sleep-related NMAs and ultimately MVAs. Drowsy driving results in thousands of unnecessary serious injuries and fatalities each year; raising public awareness that new parents are a high-risk group is important. Screening for parental sleep problems at well-baby visits may help to reduce this burden.

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Table 1

Demographics

	Near Miss or Motor Vehicle Accidents N=20	No Accidents N=52
Age (years)	28.8±7.7	26.9±5.9
Race (%)		
Caucasian	40.0%	42.5%
African American	20.0%	36.4%
Asian	20.0%	9.6%
Mixed Race	5.0%	1.9%
Missing	15.0%	9.6%
BMI (kg/m ²)	24.7±4.6	27.6±6.7
Marital Status (%)		
Married	50.0%	32.7%
Cohabiting	15.0%	3.8%
Single	25.0%	48.1%
Other	10.0%	11.5%
Currently employed (%)	70.0%	48.1%
Night Shift worker (%)	30.0%	13.5%
Diagnosis of OSA (%)	0%	3.8%
Number of children at home	1.3±0.6	1.9±1.0
First child (%)	60.0%	44.2%
Age of index child (weeks)	22.4±14.2	15.5±12.6

Data shown as mean ± standard deviation, or proportion as appropriate

BMI=Body Mass Index; OSA=obstructive sleep apnea

Table 2

Parental Sleep Patterns

	Near Miss or Motor Vehicle Accidents N=20	No Accidents N=52
Mean sleep duration (hours)	6.2±1.4	6.5±1.9
Mean Epworth Sleepiness Scale Score	7.7±3.5	6.2±4.0
% Daytime sleepiness (ESS ≥10)	30.0%	25.0%
% Snoring >3 nights/week	20.0%	19.2%
% positive OSA (STOP questionnaire)	20.0%	23.0%
Mean wakings per night	1.8±1.3	2.2±1.3
Worst problem (%)		
Sleepiness	30.0%	15.4%
Fatigue	10.0%	11.5%
Lack of energy	15.0%	30.8%
Tiredness	30.0%	30.8%
N/A	15.0%	11.5%
Mean sleep quality domain score	4.2±1.5	3.4±1.6
% poor sleep quality	70.0%	55.8%
Mean daytime function domain score	4.1±1.4	3.0±1.6*
% poor daytime function	75.0%	46.2%*

*
p<0.05

Data shown as mean ± standard deviation, or proportion as appropriate

ESS=Epworth Sleepiness Scale; OSA=Obstructive Sleep Apnea; N/A=Not Applicable

Table 3**Driving Habits**

	Near Miss or Motor Vehicle Accidents N=20	No Accidents N=52
Miles driven per week		
<50 miles	45.0%	65.4%
50–100 miles	40.0%	15.4%
100–150 miles	15.0%	7.7%
150–200 miles	0%	3.8%
200–250 miles	0%	1.9%
>250 miles	0%	5.8%
Drive for job		
Yes	30.0%	13.5%
No	55.0%	51.9%
Not currently working	15.0%	34.6%
Hours driving per day		
<0.5	35.0%	52.3%
0.5–1	15.0%	17.3%
1–3	20.0%	26.9%
3–6	20.0%	5.8%
>6	10.0%	7.7%
Hours per week driving in dark		
<0.5	30.0%	53.8%
0.5–1	30.0%	23.1%
1–3	25.0%	7.7%
3–6	10.0%	9.6%
>6	5.0%	5.8%
Frequency driving at least 30 min		
Daily/almost daily	35.0%	21.2%
3–5 days per week	10.0%	9.6%
1–2 days per week	25.0%	11.5%
Few times per month	20.0%	11.5%
<1 month	5.0%	30.8%
N/A	5.0%	15.4%
Frequency driving at least 1 hour		
Daily/almost daily	5.0%	7.7%
3–5 days per week	10.0%	9.6%
1–2 days per week	5.0%	7.7%
Few times per month	40.0%	23.1%

	Near Miss or Motor Vehicle Accidents N=20	No Accidents N=52
<1 month	40.0%	51.9%
Feeling sleepy while driving		
Daily/almost daily	5.0%	3.8%
3–5 days per week	15.0%	3.8%
1–2 days per week	5.0%	5.8%
Few times per month	40.0%	19.2%
<1 month	40.0%	67.4%
Fallen asleep while driving	15.0%	5.8%

Table 4

Regression model for near-miss accidents

Adjusted	Explanatory Variables	Odds Ratio (95%CI)			
Beta	SE	p-value			
Poor sleep quality	1.83	0.98	0.04	6.2	1.1–44.6
Night shift	2.20	0.91	0.02	8.9	1.5–53.3
Infant age (weeks)	0.01	0.03	0.72	1.0	0.9–1.1
Hours of sleep	–0.44	0.35	0.21	0.6	0.3–1.3
Miles driven per week	–0.37	0.33	0.25	0.7	0.4–1.3
STOP positive	–0.92	0.89	0.31	0.4	0.1–2.3
Single marital status	–1.07	0.79	0.17	0.3	0.1–1.6

STOP positive =positive screen for obstructive sleep apnea;
95%CI=95% Confidence Intervals.