Survey Shows...
The Hawaii Behavioral Risk Factor Surveillance System
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Sleep Related Prevalence and Associations with Selected Health Indicators

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State of Hawaii

Acknowledgement

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About the Hawaii Behavioral Risk Factor Surveillance System (HBRFSS)

The HBRFSS is an ongoing land-based random telephone survey of randomly selected adult residents 18 years and older on behaviors that affect health directly and indirectly. The HBRFSS is funded by the Centers for Disease Control and Prevention (CDC) as part of the national Behavioral Risk Factor Surveillance System (BRFSS). The HBRFSS has been in operation since 1986. For more information about HBRFSS results, please visit the following website: http://hawaii.gov/health/statistics/brfss/index.html. If the information you are looking for is not on the website, you may contact the state BRFSS coordinator via e-mail at brfsshi@doh.hawaii.gov or via phone at 808-586-4509.

MESSAGE FROM THE DIRECTOR

The State of Hawaii Department of Health is pleased to present the report about sleep derived from a population-based survey Hawaii Behavioral Risk Factor Surveillance System (HBRFSS) calendar year 2009.

Sleep affects public health and safety, so much so that on a yearly basis, a week during the month of March is dedicated as *National Sleep Awareness Week*. The lack of sleep evidenced by drowsy/fatigue drivers account for thousands of fatalities and non-fatal injuries in the nation as reported by the National Highway Traffic Safety Administration. While it is not known how many of the vehicular crashes in the state are due to drowsy driving unless reported by the driver or the passengers themselves, there is now an estimate of the number of drowsy drivers in the state as of calendar year 2009. This report titled "*Sleep Related Prevalence and Associations with Selected Health Indicators* estimated that the number of drowsy drivers in the state of Hawaii is about 55,000 adults. The report also presents the prevalence of: sleep insufficiency, frequent unintentional falling asleep, and snoring among adults in the state of Hawaii as well as associations of frequent lack of sleep with unhealthy behaviors such as smoking and physical inactivity and with chronic health conditions including both physical and mental.

We hope that this report will be used for integrated planning, implementation and evaluation of programs to improve the health condition of the people of Hawaii especially those who are in the most vulnerable circumstance.

This report would not have been possible without the survey participation of the people of Hawaii. Together we can work for a healthier Hawaii.

Sincerely,

Chiyome Leinaala Fukino, M.D.
Director of Health

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EXECUTIVE SUMMARY

Descriptive statistical analysis is applied in examining the results of the sleep module component of the Hawaii Behavioral Risk Factor Surveillance System (HBRFSS) survey for calendar year 2009. Test of significance is based on alpha=5%.

Highlights of this report are:

- More than 2 out of 5 adults (44%) in the state of Hawai‘i lack seven hours of sleep per night. Equivalently, it represents about 433,000 adult residents in the state.

- Prevalence of
  - ⇒ drowsy driving is 5.8% (w/95%CI 5.0%-6.8%) equivalent to about 55,000 drowsy drivers
    significantly higher proportion of drowsy drivers are employed (85.6%) compared to non=drowsy drivers (61.0%)
  - ⇒ frequent unintentional falling sleep is 8.8% (w/95%CI 7.8%-9.9%)
  - ⇒ frequent insufficient rest or sleep is 24.7% (w/95% 23.1%-26.3%)
    highest prevalence is for those adults unable to work, 48.9%
  - ⇒ snoring is 51.3% (w/95%CI 49.5%-53.1%)

- Adjusted odds ratios (adjusting for age, gender, ethnicity, education, employment, and marital status) showed that frequent insufficient rest or sleep is associated with
  - ⇒ experience of heart attack, stroke, asthma, COPD, arthritis, cancer, high blood cholesterol, activity limitation and use of special equipment
  - ⇒ frequent physical distress, frequent mental distress and serious psychological distress as well as life dissatisfaction
  - ⇒ smoking and physical inactivity

Lack of sleep could lead to serious chronic health problems including stroke, asthma, cancer, COPD, and arthritis. Lack of sleep also impairs mental alertness which in turn put individuals at higher risk for vehicular accidents, certain unhealthy behaviors, and mental health issues. Physiologic studies suggest insufficient sleep puts stress on the body, increasing the production of stress hormones, including inflammatory markers which are major risk factors for heart disease, diabetes, stroke, and cancer, and could explain the results of this study.

Further studies concerning the association of sleep deprivation and health problems are warranted and as more studies conclude with similar results, this could be an important public health and medical intervention in the fight to reduce chronic disease.

Sleep Related Prevalence and Associations with Selected Health Indicators

Florentina Reyes-Salvail, M.Sc., Shu Liang, M.B.A., and Lela McKnight-Eily, Ph.D.

Introduction

It is estimated that between 50 and 70 million American adults suffer from chronic sleep or wakefulness disorders and up to 100 million have occasional sleep problems[1]. The National Sleep Foundation reported in March 2009 that the number of adults reporting sleep problems has increased by 13% since 2001[2]. Sleep problems like deprivation, daytime sleepiness, snoring are very common. The cumulative effect of sleep loss and sleep disorders represent an under-recognized public health problem and contributes to a major public safety problem- drowsy driving[3,4]. Data from the National Highway Traffic Safety Administration showed that annual averages of roughly 40,000 nonfatal injuries and 1,550 fatalities result from crashes, in which the driver was drowsy/fatigue[5]. Further, sleep disorders can lead to impaired life quality, decreased productivity, increased use of health care service, and result in injury or death[3,6]. Previous research suggests that insufficient sleep is associated with a wide range of health consequences including impaired physical and/or mental health[7,8,9,10]. Specifically, insufficient sleep and sleeping disorders are associated with chronic diseases including obesity, heart disease and stroke; mental disorders such as depression and anxiety; risk behaviors including smoking and physical inactivity, and negatively impact quality of life, productivity, and functionality[7,11]. Recognizing the health consequences of sleep disorders and sleep deprivation, the primary purpose of this study was to assess the prevalence of insufficient rest or sleep, frequent unintentional sleep during the day, snoring, and drowsy driving as well as to examine the associations between frequent insufficient rest or sleep and selected health indicators among Hawaii adult residents.

Data Source and Methods

Data used in this report are from the 2009 Hawaii Behavioral Risk Factor Surveillance System survey, which contained data collected from 6683 adult respondents' ages 18 years and older.

Sleep Related Prevalence and Associations with Selected Health Indicators

The 2009 Hawaii BRFSS survey participation[i] rate calculated according to the Council on American Survey Research Organization (CASRO) method is estimated at 45.6%. This participation rate is well above the 41% minimum participation requirement of CDC. Another measure of participation rate is the cooperation rate[ii]. The cooperation rate is the proportion of all respondents interviewed of all eligible units in which a respondent was selected and actually contacted. Non-contacts are excluded from the denominator. This rate is based on contacts with households containing an eligible respondent. The denominator of the rate includes completed interviews plus the number of non-interviews that involve the identification of and contact with a selected respondent. The cooperation rate for Hawaii is 68.9% which is above the minimum requirement of 65%.

There were 5 questions related to insufficient sleep or sleep-related problem behaviors in the 2009 Hawaii BRFSS. Respondents were asked the following sleep questions:

1. "During the past 30 days, for about how many days have you felt you did not get enough rest or sleep?"
2. "On average, how many hours of sleep do you get in a 24-hour period? Think about the time you actually spend sleeping or napping, not just the amount of sleep you think you should get"
3. "Do you snore?"
4. "During the past 30 days, for about how many days did you find yourself unintentionally falling asleep during the day and
5. "During the past 30 days, have you ever nodded off or fallen asleep, even just for a brief moment, while driving?" (1 or more days categorized as engaging in drowsy driving).

Frequent insufficient rest or sleep indicator (also called **Frequent rest or sleep insufficiency**), was derived from question 1 if answers were 14 to30 days. Similarly, ***frequent unintentional falling asleep*** was derived from question 4 if answers were 14 to30 days. Question 5 was also used to define ***drowsy driving*** as 1 or more days nodded off in the past 30 days. Responses to question 2 was categorized as < 7 hours and >=7 hours. Mean number of sleep hours was also derived from question 2.

[i] The percentage of persons who completed interviews among all eligible persons, including those who were not successfully contacted

[ii] The percentage of persons who completed interviews among all eligible persons who were contacted

Sleep Related Prevalence and Associations with Selected Health Indicators

We examine associations between frequent insufficient rest or sleep and some selected health indicators. The list of selected health indicators is shown in the table1.

Table 1. Selected health indicators, HBRFSS 2009

Physical health condition	
Poor or fair general health	Current asthma
Frequent physical distress (FPD)	Obesity
	Chronic obstructive pulmonary disease (COPD)
Snoring	Arthritis
Heart attack	Hypertension (High blood pressure)
Angina	High blood cholesterol
Stroke	Activity limitation
Diabetes	Use special equipment
Mental health condition	
Frequent mental distress (FMD)	Serious psychological distress (SPD)
Risk behavior	
Binge drinking	Physically inactive
Heavy drinking	Drowsy driving
current smoking	
Self-perceived life satisfaction	
Self-reported life satisfaction	

Perceived general health was assessed by asking respondents to rate their general health from excellent to very good, good, fair and poor. Lifetime chronic disease diagnoses were assessed by asking respondents if they had ever been told by a doctor, nurse, or other health professional that they had some form of arthritis, a heart attack (also called a myocardial infarction), angina or coronary heart disease, a stroke, high blood pressure (hypertension), high blood cholesterol, diabetes, asthma, and chronic obstructive pulmonary disease (COPD). Current asthma was defined if a person was told that he/she had asthma and he/she still has asthma. A person was considered obese if his/her BMI was equal or greater than 30. Body mass index (BMI) is defined as weight in kilograms divided by the square of height in meters, that is, BMI= (Weight in Kg)/(Height in meters)^2).

If a person did not participate in any physical activities or exercise other than his/her regular jobs during the past month, he/she was considered to be physically inactive. A positive response to

question 'Are you limited in any way in any activities because of physical, mental, or emotional problems?' was considered as having activity limitations.
If a person responded 'yes' to 'Do you now have any health problem that requires you to use special equipment, such as a cane, a wheelchair, a special bed, or a special telephone?' he/she were considered as using special equipment.

BRFSS respondents were also asked about their perceived physical and mental health: "Now, thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?", "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?". Persons who reported that their physical health or mental health was not good for 14 or more days in the prior month were identified to have frequent physical distress (FPD) or frequent mental distress (FMD).

Serious psychological distress (SPD)[12,13] was derived from response to the Kessler 6, a measure of generalized psychological distress developed for use in general population sample. Kessler 6 questions asked respondents during the past 30 days about how often did they feel nervous, hopeless, restless, so depressed that nothing could cheer them up, everything was an effort, and worthless respectively. Possible answers for any of these 6 questions are "none of the time", "a little of the time", "some of the time", "most of the time", or "all of time". Each answer was transformed into a corresponding score of 0 to 4 and all the scores for the six questions of each respondent were summed up to yield the Kessler 6 score. Respondents who had a score of 13 or greater were identified as having SPD.

Questions related to health risk behaviors including binge drinking and current smoking were also asked in BRFSS. Binge drinking in CDC/BRFSS definition is having five or more drinks for men or four or more drinks for women on an occasion in the past thirty days. Heavy drinking is having more than two drinks per day for men or more than one drink per day for women. Current smoker was defined as a person who smoked at least 100 cigarettes in his/her entire life and now smokes cigarettes every day or some days.

Sleep Related Prevalence and Associations with Selected Health Indicators

Life satisfaction was self-assessed by BRFSS respondents in answer to question about how satisfied were they with their life. Possible answers are very satisfied, satisfied, dissatisfied, and very dissatisfied.

The statistical analyses included in this report were done using SAS 9.1.3 and SAS callable SUDAAN 10 software (Research Triangle Institute, 2009). For all the analyses, $\alpha = 5\%$ was used as the significance criterion. We examined age adjusted prevalence of insufficient rest or sleep, frequent unintentional falling asleep, snoring, and drowsy driving. Number of days of perceived insufficient rest or sleep was categorized into 0 days, 1-13 days, 14-29 days, 30 days as well as 14-30 days (frequent rest or sleep insufficiency). Analyses were stratified by county, age, gender, ethnicity, educational level, employment status, and marital status. Age adjusted prevalence of selected health indicators by frequent rest or sleep insufficiency status were calculated. Adjusted logistic regression analyses were conducted to examine the odds of selected health indicators for people without frequent rest or sleep insufficiency compared to people with frequent rest or sleep insufficiency adjusting for age, gender, ethnicity, education, employment, and marital status.

Results

Average Sleep Hours per Day

A significant proportion of Hawaii adults (44.3%) report getting less than 7 hours of sleep on average every day (Figure 1). About 4% of these adults reported sleeping less than 5 hours per day. Hawaii adults who got 8 hours or more sleep per day were less than 28% of the population. Looking at the average in terms of the mean number of daily sleep hours, for Hawaii adults, it was 6.9 hours. Both females and males reported the same number of average sleeping hours (Table 2). Adults 18-24 years of age and 65 years of age and older reported an average of 7.1 sleep hours per day, slightly longer than the average number of sleeping hours per day of adults in age groups between 25 to 64 years old. The average number of sleep hours per day of Hawaii's five major ethnic groups (White, Hawaiian, Chinese, Filipino, and Japanese) varied but the differences between any two groups were not statistically significant ($p>0.05$). Among

them, Chinese adults had the longest average daily sleeping hours (7.1 hours) and Japanese had the shortest daily average sleeping hours (6.6 hours).

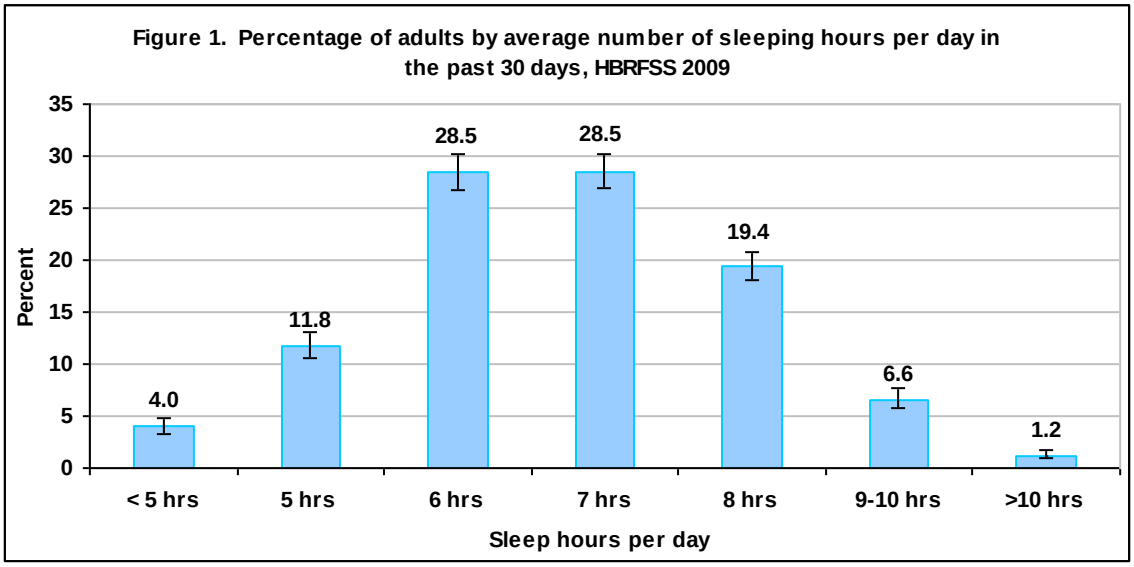


Table 2. Mean sleep hours per day in past 30 days, BRFSS 2009

	N (Sample size)	Number of hours	95% CI*
State	6336	6.9	6.8 - 7.0
Gender			
Male	2624	6.9	6.7 - 7.1
Female	3712	6.9	6.8 - 7.0
Age			
18-24 yrs	254	7.1	6.9 - 7.4
25-34 yrs	541	6.9	6.5 - 7.4
35-44 yrs	847	6.7	6.6 - 6.9
45-54 yrs	1316	6.8	6.6 - 7.0
55-64 yrs	1475	6.7	6.6 - 6.8
65+ yrs	1868	7.1	6.9 - 7.4
Ethnicity			
White	2691	7.0	6.9 - 7.1
Hawaiian	729	6.9	6.6 - 7.2
Chinese	307	7.1	6.4 - 7.7
Filipino	772	6.8	6.5 - 7.0
Japanese	1410	6.6	6.5 - 6.8
Others	427	7.4	6.6 - 8.2

*Confidence interval

Sleep Related Prevalence and Associations with Selected Health Indicators

Prevalence of Insufficient Rest or Sleep

Prevalence of insufficient rest or sleep by number of days is presented in Table3. Frequent rest or sleep insufficiency prevalence is presented on last column of Table3. In 2009, 10.6% of Hawaii adult residents (or nearly one in ten adults) reported insufficient rest or sleep every day in the past 30 days. In contrast, 37.5% of Hawaii adult residents reported no days of insufficient rest or sleep during the past 30 days. The prevalence of insufficient rest or sleep in each of the counties does not differ much from each other.

No days of insufficient rest or sleep

The prevalence of no days of insufficient rest or sleep increased with age group; from 25.2% for age 18-24 years to 63.8% for age 65 years or older. Consistent with this result, about the same percentage of retired persons, 64.5% reported no days of insufficient rest or sleep, significantly higher than persons who were employed (32.7%), unemployed (33.6%), unable to work (23.0%), or student/Homemaker (25.8%). Looking at other demographic characteristics, males were significantly more likely than females to report no days of insufficient rest or sleep (39.2% vs. 35.7%). Chinese (46.2%) and Filipinos (43.7%) were significantly more likely to report no days of insufficient sleep in comparison to Hawaiian (32.8%), White (36.3%). Adults with less than high school (46.4%) or high school (42.6%) education were more likely to report no days of insufficient rest or sleep than those with some college (35.0%) or college (34.3%) education. Persons who were never married (30.0%) reported the lowest rate of no days of insufficient sleep among four marital statuses.

Frequent insufficient rest or sleep

About one in four (24.7%) Hawaii adults reported frequent insufficient (14-30 days) rest or sleep (Table 3, last column). Among four counties, Honolulu (25.5%) has the highest and Kauai (20.7%) has the lowest rate. Across age groups, except age group of 18-24, prevalence of frequent insufficient rest or sleep decreases as age group increases, from 33.5% for the group of 25-34 years to 12.8% for the group of 65 years or older. For age groups of 35-44, 45-54, 55-64, and 65 years or older, the differences of frequent insufficient rest or sleep prevalence between each of the two consecutive age groups are statistically significant. Males (23.6%) reported a lower prevalence of frequent insufficient rest or sleep than females (25.7%), but the difference is not significant. White (24.6%), Hawaiian (29.0%), and Japanese (24.4%) had a similar rate of frequent insufficient rest or sleep which is significantly higher than the rate of Filipino (17.8%).

Table 3. Percentage of adults reporting insufficient rest or sleep in the past 30 days by number of days of perceived insufficient rest or sleep and selected demographic characteristics, HBRFSS 2009

	Number of days of perceived insufficient rest or sleep				Frequent insufficient rest or sleep (≥ 14 days not enough rest or sleep)
	0 days (no days)	1-13 days	14-29 days	30 days	
	% (95% CI*)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
State	37.5 (35.8 - 39.1)	37.8(36.1 - 39.6)	14.1 (12.8 - 15.5)	10.6 (9.5 - 11.7)	24.7 (23.1 - 26.3)
County					
Honolulu	37.0 (34.8 - 39.2)	37.5 (35.3 - 39.8)	14.7 (13.0 - 16.5)	10.9 (9.5 - 12.4)	25.5 (23.5 - 27.7)
Hawaii	37.8 (34.8 - 41.0)	38.1 (34.9 - 41.5)	13.7 (11.5 - 16.2)	10.4 (8.6 - 12.6)	24.1 (21.3 - 27.0)
Kauai	41.2 (36.1 - 46.5)	38.2 (33.3 - 43.3)	12.3 (8.6 - 17.3)	8.3 (6.1 - 11.3)	20.7 (16.4 - 25.7)
Maui	38.7 (35.3 - 42.2)	39.5 (35.9 - 43.2)	11.8 (9.8 - 14.2)	10.0 (8.0 - 12.5)	21.8 (19.0 - 24.9)
Age					
18-24 yrs	25.2 (19.7 - 31.7)	46.9 (39.6 - 54.3)	19.3 (13.7 - 26.6)	8.6 (5.4 - 13.4)	27.9 (21.5 - 35.3)
25-34 yrs	24.2 (20.2 - 28.8)	42.3 (37.4 - 47.5)	17.9 (14.3 - 22.3)	15.5 (12.3 - 19.4)	33.5 (28.9 - 38.4)
35-44 yrs	28.4 (24.6 - 32.4)	41.1 (37.1 - 45.2)	17.0 (14.2 - 20.3)	13.5 (10.8 - 16.7)	30.5 (26.8 - 34.5)
45-54 yrs	34.9 (31.6 - 38.3)	40.1 (36.8 - 43.4)	15.7 (13.5 - 18.4)	9.3 (7.5 - 11.4)	25.0 (22.2 - 28.1)
55-64 yrs	43.4 (40.1 - 46.7)	36.9 (33.8 - 40.1)	10.9 (9.2 - 12.9)	8.8 (6.9 - 11.1)	19.7 (17.2 - 22.4)
65+ yrs	63.8 (61.0 - 66.5)	23.4 (21.0 - 25.9)	5.5 (4.4 - 6.9)	7.3 (5.9 - 9.0)	12.8 (11.0 - 14.9)
Gender					
Male	39.2 (36.7 - 41.8)	37.2 (34.6 - 39.8)	13.2 (11.4 - 15.3)	10.4 (8.8 - 12.1)	23.6 (21.3 - 26.0)
Female	35.7 (33.6 - 37.9)	38.5 (36.3 - 40.8)	14.9 (13.2 - 16.9)	10.8 (9.4 - 12.3)	25.7 (23.7 - 27.9)
Ethnicity					
White	36.3 (33.9 - 38.8)	39.2 (36.6 - 41.8)	15.2(13.2 - 17.3)	9.4 (7.9 - 11.1)	24.6 (22.2 - 27.0)
Hawaiian	32.8 (28.3 - 37.5)	38.3 (33.3 - 43.5)	15.8 (11.9 - 20.7)	13.2 (10.4 - 16.5)	29.0 (24.4 - 34.0)
Chinese	46.2 (39.2 - 53.3)	29.4 (23.3 - 36.2)	14.5 (9.9 - 20.7)	9.9 (6.2 - 15.5)	24.5 (18.6 - 31.5)
Filipino	43.7 (38.9 - 48.7)	38.5 (33.7 - 43.7)	9.8 (7.0 - 13.5)	8.0 (5.8 - 10.9)	17.8 (14.2 - 21.9)
Japanese	38.2 (34.9 - 41.5)	37.4 (34.0 - 41.1)	13.0 (10.7 - 15.7)	11.4 (9.1 - 14.2)	24.4 (21.3 - 27.8)
Others	29.5 (24.1 - 35.5)	38.1 (32.0 - 44.6)	18.3 (13.2 - 24.7)	14.2 (10.1 - 19.5)	32.4 (26.3 - 39.2)
Education					
<High School	46.4 (38.4 - 54.5)	29.0 (22.1 - 36.9)	10.6 (6.0 - 18.2)	14.1 (9.3 - 20.7)	24.7 (18.0 - 32.9)
High School	42.6 (39.3 - 45.9)	34.0 (30.7 - 37.4)	11.3 (9.3 - 13.6)	12.2 (10.1 - 14.7)	23.5 (20.7 - 26.5)
Some College	35.0 (32.0 - 38.2)	37.7 (34.3 - 41.1)	16.6 (13.8 - 19.8)	10.7 (8.8 - 12.9)	27.3 (24.1 - 30.7)
College	34.3 (31.9 - 36.8)	42.1 (39.5 - 44.7)	14.8 (13.0 - 16.8)	8.8 (7.3 - 10.5)	23.6 (21.4 - 26.0)
Employment status					
Employed	32.7 (30.7 - 34.9)	41.4 (39.1 - 43.6)	15.6 (14.0 - 17.3)	10.3 (9.0 - 11.8)	25.9 (23.9 - 28.0)
Unemployed	33.6 (27.1 - 40.8)	40.0 (32.6 - 47.9)	14.8 (9.9 - 21.5)	11.6 (7.9 - 16.8)	26.4 (20.2 - 33.6)
Unable to work	23.0 (15.9 - 32.1)	28.0 (19.4 - 38.7)	24.3 (12.8 - 41.3)	24.6 (16.3 - 35.4)	**48.9** (36.8 - 61.2)
Retired	64.5 (61.7 - 67.3)	23.2 (20.8 - 25.7)	5.7 (4.6 - 7.1)	6.6 (5.1 - 8.3)	12.3 (10.5 - 14.4)
Student/Homemaker	25.8 (20.9 - 31.2)	42.6 (36.1 - 49.3)	16.6 (12.0 - 22.6)	15.0 (11.1 - 20.1)	31.7 (25.8 - 38.2)
Marital status					
Married, partner	38.3 (36.3 - 40.3)	36.8 (34.8 - 38.8)	13.6 (12.3 - 15.1)	11.3 (10.0 - 12.8)	24.9 (23.1 - 26.8)
Divorced/separated	37.9 (33.6 - 42.5)	38.7 (34.2 - 43.4)	13.4 (10.6 - 16.8)	10.0 (7.7 - 12.9)	23.4 (19.8 - 27.4)
Widow	58.9 (53.8 - 63.8)	26.6 (22.2 - 31.4)	6.8 (4.8 - 9.6)	7.7 (5.5 - 10.7)	14.5 (11.5 - 18.3)
Never married	30.0 (26.3 - 34.1)	43 (38.5 - 47.6)	17.2 (13.7 - 21.5)	9.7 (7.5 - 12.6)	27.0 (22.9 - 31.4)

* Confidence internal

Sleep Related Prevalence and Associations with Selected Health Indicators

When stratified by level of education received, prevalence of frequent insufficient rest or sleep did not vary significantly. However, by employment status, nearly one in two adults unable to work (48.9%) reported frequent rest or sleep insufficiency, almost twice that of the state (24.7%) and differs significantly from students/homemakers (31.7%), unemployed (26.4%), employed (25.9%) and retired (12.3%) persons. Widowed (14.5%) person were significantly less likely to report frequent insufficient rest or sleep compared to adults who were married (24.9%), divorced/separated (23.4%) or never married (27.0%).

Prevalence of Frequent Unintentional Falling Sleep

About 8.8% of Hawaii adults reported frequent unintentional falling asleep (unintentionally falling asleep off during the day for 14 or more days in the preceding 30 days, Table 4).

Table 4. Prevalence of frequent unintentionally falling sleep, drowsy driving, and snoring by selected demographic characteristics, HBRFSS 2009.

	Frequent unintentionally falling asleep	Drowsy driving	Snoring
	% (95% CI*)	% (95% CI)	% (95% CI)
State	8.8 (7.8 - 9.9)	5.8 (5.0 - 6.8)	51.3 (49.5 - 53.1)
County			
Honolulu	9.3 (8.0 - 10.7)	5.6 (4.6 - 6.8)	51.2 (48.8 - 53.6)
Hawaii	7.3 (5.5 - 9.6)	5.9 (4.3 - 8.2)	51.4 (48.0 - 54.7)
Kauai	5.5 (3.9 - 7.7)	6.0 (4.1 - 8.5)	47.5 (42.2 - 52.9)
Maui	8.8 (6.7 - 11.5)	7.2 (5.3 - 9.8)	53.1 (49.4 - 56.8)
Age			
18-24 yrs	7.7 (4.5 - 12.9)	3.3 (1.6 - 6.7)	34.4 (27.5 - 42.0)
25-34 yrs	8.6 (5.9 - 12.2)	9.8 (7.1 - 13.4)	44.4 (39.2 - 49.8)
35-44 yrs	8.4 (6.2 - 11.2)	8.3 (6.2 - 11.1)	54.9 (50.5 - 59.1)
45-54 yrs	6.2 (4.7 - 8.3)	6.1 (4.5 - 8.3)	60.3 (56.9 - 63.7)
55-64 yrs	6.4 (4.9 - 8.4)	4.5 (3.2 - 6.3)	62.1 (58.8 - 65.3)
65+ yrs	14.5 (12.5 - 16.8)	2.3 (1.7 - 3.1)	47.6 (44.7 - 50.5)
Gender			
Male	9.3 (7.8 - 11.0)	7.9 (6.5 - 9.6)	60.2 (57.5 - 62.9)
Female	8.3 (7.0 - 9.7)	3.8 (3.1 - 4.7)	42.4 (40.1 - 44.7)
Ethnicity			
White	6.2 (4.8 - 7.9)	4.0 (3.0 - 5.3)	47.3 (44.7 - 50.0)
Hawaiian	9.1 (6.4 - 12.8)	9.1 (6.5 - 12.7)	58.3 (52.9 - 63.5)
Chinese	9.2 (5.9 - 14.2)	7.2 (3.6 - 13.8)	49.9 (42.6 - 57.3)
Filipino	9.4 (7.0 - 12.7)	6.0 (4.2 - 8.6)	53.4 (48.2 - 58.5)
Japanese	10.9 (8.9 - 13.3)	4.5 (3.2 - 6.2)	55.1 (51.5 - 58.7)
Others	10.2 (6.9 - 14.9)	9.7 (6.5 - 14.4)	43.2 (36.8 - 49.9)

* Confidence interval

Sleep Related Prevalence and Associations with Selected Health Indicators

Honolulu (9.3%) and Maui (8.8%) had a significantly higher prevalence of frequent unintentionally falling asleep than Kauai (5.5%). Adults aged 65 years or older (14.5%) were significantly more likely than adults in other age group to report frequent unintentionally falling asleep in the preceding 30 days. Males (9.3%) had a higher prevalence of frequent unintentionally falling asleep than female (8.3%) but the difference of the two rates is not significant. Whites (6.2%) had the lowest prevalence of frequent unintentionally falling asleep among five major ethnic groups, which is significantly lower than the rate of Japanese (10.9%) and Filipino (9.4%).

Prevalence of Drowsy Driving

As shown in Table 4, about 5.8% of Hawaii adults – potentially 55,000 licensed drivers – have nodded off or fallen asleep at least once when driving a vehicle in the past 30 days. Employed persons accounted for 85.6% of drowsy drivers in the state of Hawaii in 2009, followed by unemployed (5.9%) and retired (5.6%) adults, students/homemakers (2.5%), and those who were unable to work (0.4%, Figure 2). In the group of non-drowsy drivers, employed adults only accounted for 61.0%, which is significantly lower than the percentage of employed adults in the group of drowsy drivers.

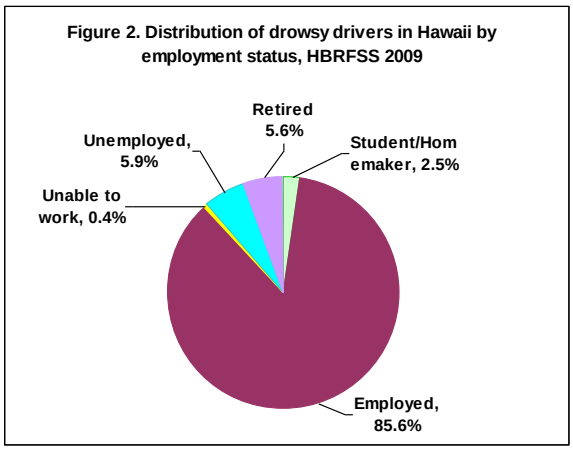


Figure 2. Distribution of drowsy drivers in Hawaii by employment status, HBRFSS 2009

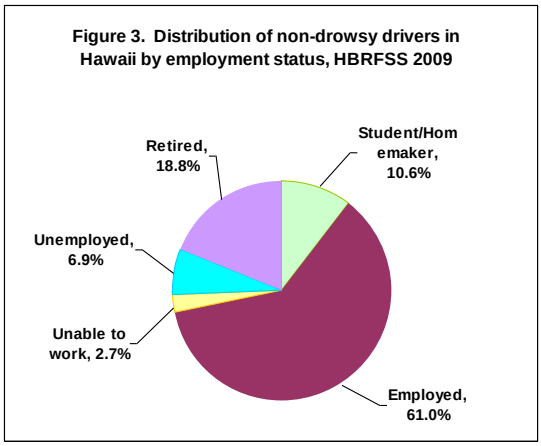


Figure 3. Distribution of non-drowsy drivers in Hawaii by employment status, HBRFSS 2009

Prevalence of drowsy driving varies in Hawaii's four counties but the differences are not significant. A small prevalence of drowsy driving was observed among adults in the two end of age groups, 18-24 years (3.3%) and 65 years or older (2.3%). For adults aged 25 years and

older, as age increases prevalence of drowsy driving decreased. Males (7.9%) were significantly more likely than females (3.8%) to report drowsy driving. Hawaiians (9.1%) reported the highest drowsy driving prevalence among five major ethnic groups in the state, which is significantly higher than Whites (4.0%) and Japanese (4.5%).

Prevalence of Snoring

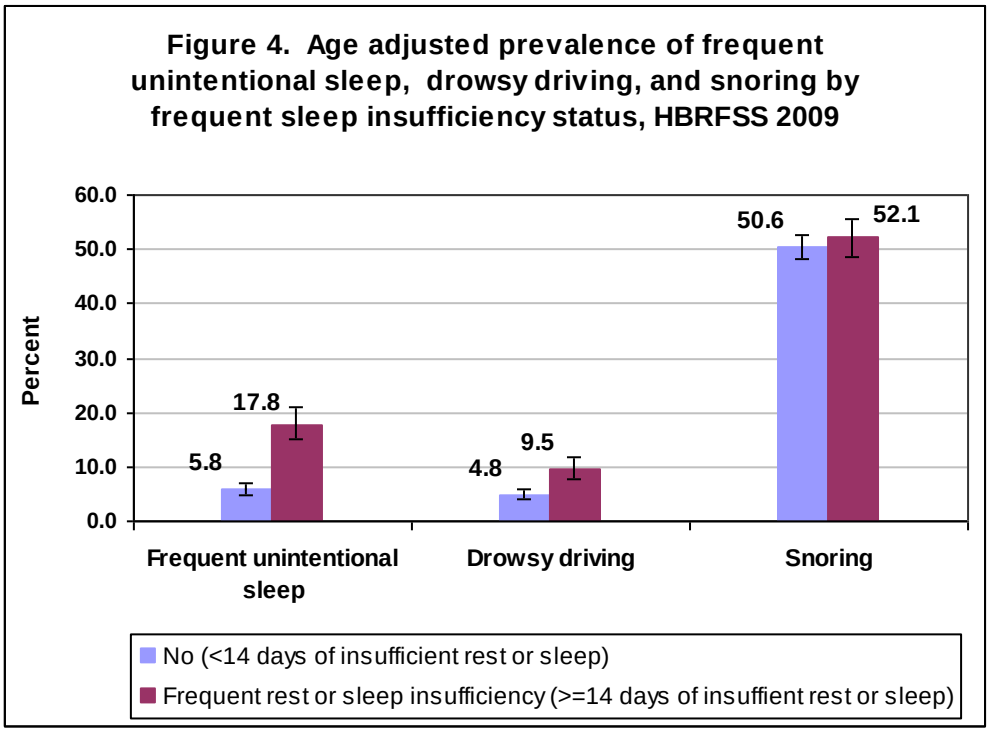
Slightly more than half (51.3%) of the Hawaii adults reported that they snore as shown in Table 4. Table 4 also showed that as age group increased (from 18 to 64 years old), the prevalence of snoring increased. The differences of snoring prevalence between any two consecutive age groups of 18-24 (34.4%), 25-34 (44.4%), 35-44 (54.9%), and 45-54 (60.3%) years are significant. Adults aged 65 years or older (47.6%) reported a significantly lower prevalence of snoring than those who were in age group of 35-64. Snoring is significantly more common among males (60.2%) than females (42.4%).

Age-adjusted prevalence by frequent insufficient rest or sleep

Adults with frequent insufficient rest or sleep are significantly younger (median age of 42.2 years, 95%CI 41.0 to 43.5) compared to adults with frequent sufficient rest or sleep (median age of 48.5 years, 95%CI 47.7 to 49.3) thus age adjustment was applied to the prevalence rate displayed in Figure 4. Adults who reported frequent insufficient rest or sleep were more than three times as likely to experience frequent unintentional falling asleep (17.8% vs. 5.8%) and nearly twice as likely to experience drowsy driving (9.5% vs. 4.8%) as adults who did not suffer from frequent rest or sleep insufficiency in the past 30 days (Figure 4). Prevalence of snoring did not vary significantly between adults with frequent rest or sleep insufficiency (52.1%) and without frequent rest or sleep insufficiency (50.6%).

Selected Health Indicators by Frequent Insufficient Rest or Sleep Status

Table 5 age-adjusted prevalence indicates that adults who suffered from frequent insufficient rest or sleep were significantly more likely than those without frequent insufficient rest or sleep to report fair/poor general health (22.3% vs. 10.3%), frequent physical distress (18.7% vs. 4.8%),



heart attack (4.0% vs. 2.3%), hypertension (31.6% vs. 27.5%), high blood cholesterol (40.9% vs. 32.2%), obesity (26.3% vs. 22.4%), arthritis (25.5% vs. 17.7%), asthma (14.1% vs. 7.8%), COPD (4.3% vs. 2.3%), frequent mental distress (17.1% vs. 4.2%), serious psychological distress (6.4% 1.0%), have activity limitation (22.9% vs.11.9%), and use special equipment (6.8% vs. 4.0%). Test of association after adjusting for age, gender, ethnicity, education, employment, and marital status showed frequent insufficient rest or sleep is significantly associated with all the mentioned indicators except for obesity (AOR=1.2, CI=1.0-1.5) and hypertension (AOR=1.3, CI=1.0-1.5).

Adults who suffered from frequent rest or sleep insufficiency were also significantly more likely than those without frequent rest or sleep insufficiency to engage in unhealthy life style choices including smoking and being physically inactive. These associations were maintained even after controlling for age, gender, ethnicity, education, employment, and marital status reflected in the respective AOR above one (current smoking 1.5, physically inactive 1.4) and lower confidence intervals greater than one.

Table 5. Age adjusted prevalence and adjusted odds ratio of selected health indicators, HBRFSS 2009

Selected health indicators	Age adjusted prevalence of selected health indicators by frequent insufficient sleep status		Adjusted** odds ratio (AOR) of selected health indicators	
	Frequent insufficient rest or sleep % (95% CI*)	No frequent insufficient rest or sleep % (95% CI)	Frequent insufficient rest or sleep % (95% CI)	No frequent insufficient rest or sleep
Physical health condition				
Poor or fair general health	**22.3 (19.6 - 25.3)**	**10.7 (9.6 - 12.0)**	**2.5 (2.0 - 3.1)**	Referent
Frequent physical distress	**18.7 (16.4 - 21.2)**	**4.8 (4.1 - 5.6)**	**4.5 (3.5 - 5.8)**	Referent
Heart attack	**4.0 (2.9 - 5.6)**	**2.3 (1.9 - 2.8)**	**1.7 (1.1 - 2.5)**	Referent
Angina or coronary heart disease	2.8 (1.9 - 4.2)	2.3 (1.8 - 2.8)	1.5 (1.0 - 2.3)	Referent
Stroke	**3.0 (2.1 - 4.2)**	**2.1 (1.7 - 2.6)**	**1.6 (1.1 - 2.4)**	Referent
Diabetes	9.0 (7.4 - 10.8)	7.4 (6.5 - 8.4)	1.3 (1.0 - 1.7)	Referent
Asthma	**14.1 (11.8 - 16.7)**	**7.8 (6.8 - 9.0)**	**1.8 (1.4 - 2.3)**	Referent
Obesity (BMI>=30)	**26.3 (23.1 - 29.8)**	**22.4 (20.6 - 24.4)**	1.2 (1.0 - 1.5)	Referent
COPD	**4.3 (3.2 - 5.7)**	**2.3 (1.9 - 3.0)**	**1.8 (1.2 - 2.7)**	Referent
Arthritis	**25.5 (23.0 - 28.3)**	**17.7 (16.6 - 18.9)**	**1.8(1.5 - 2.2)**	Referent
Had cancer	**10.3 (8.6 -12.3)**	**7.4 (6.6 – 8.2)**	**1.5 (1.2 – 2.0)**	Referent
Hypertension	**31.6 (28.9 - 34.4)**	**27.5 (26.0 - 29.1)**	1.3 (1.0 - 1.5)	Referent
High blood cholesterol	**40.9 (37.4 - 44.6)**	**32.2 (29.9 - 34.7)**	**1.6 (1.4 - 2.0)**	Referent
With activity limitation	**22.9 (20.2 - 25.7)**	**11.9 (10.7 - 13.2)**	**2.3 (1.8 - 2.9)**	Referent
Use special equipment	**6.8 (5.6 - 8.4)**	**4.0 (3.4 - 4.7)**	**1.9 (1.4 - 2.5)**	Referent
Mental health condition				
Frequent mental distress	**17.1 (14.9 - 19.7)**	**4.2 (3.4 - 5.1)**	**4.3 (3.3 - 5.7)**	Referent
Serious psychological distress	**6.4 (5.0 - 8.1)**	**1.0 (0.7 - 1.5)**	**7.0 (4.3 - 11.1)**	Referent
Risk behavior				
Binge drinking	18.8 (16.0 - 21.9)	17.5 (15.8 - 19.3)	1.1 (0.8 - 1.4)	Referent
Heavy drinking	7.3 (5.7 - 9.3)	6.3 (5.3 - 7.4)	1.0 (0.7 - 1.3)	Referent
Current smoking	**20.4 (17.7 - 23.4)**	**14.1 (12.6 - 15.7)**	**1.5 (1.2 - 1.9)**	Referent
Physically inactive	**24.2 (21.4 - 27.1)**	**18.2 (16.6 - 19.9)**	**1.4 (1.2 - 1.8)**	Referent
Self-perceived life satisfaction				
Dissatisfied or very dissatisfied with life	**8.1 (6.4 - 10.3)**	**2.0 (1.5 - 2.6)**	**4.6 (3.1 - 6.8)**	Referent

* Confidence interval
** Adjusting for age, gender, ethnicity, education, employment, and marital status
***Bolded numbers indicates significance

Discussion, Conclusion and Recommendation

The number of sleep hours needed for most adults to feel fully rested is 7 to 9 hours each night per recommendation of the National Sleep Foundation[14]. The findings of this study showed the state of Hawaii's average did not meet that recommendation. On average, the state's adults mean

number of daily sleep is 6.9 hours, which is the same as the national level[4]. In addition, more than two out of five adults (44.3%) in our state do not have seven hours of sleep per day which may suggest a state-wide sleep problem.

While some Hawaii adults lack sleep or rest, there were some with no insufficiency in rest or sleep. The state's adults were more likely to report no days of rest or sleep insufficiency compared to their mainland counterparts[15]. The prevalence of no days of rest or sleep insufficiency for Hawaii is 37.5%, which is significantly higher than the national average of 30.7%[16]. Our results are consistent with the national data that males were more likely than females, and older adults are more likely than younger adults, to report no days of insufficient rest or sleep[17]. Another indicator for lack of rest or sleep is the frequent insufficient rest or sleep (14 days or more in the preceding 30 days felt did not get enough rest or sleep) prevalence. It is also referred to as frequent rest or sleep insufficiency. For the state, 24.7% (nearly one in four adults) experienced frequent insufficient rest or sleep. This prevalence is significantly lower than the estimated prevalence for the nation at 27.9%[17]. In addition, similar to the national findings of CDC[12], older persons in the state, especially those who are 65 years or older have lower prevalence of frequent insufficient rest or sleep. It may be because they are retired and therefore have the time to relax and rest. On the other hand, the prevalence of frequent insufficient rest or sleep is highest among adults that are unable to work (48.9%). Perhaps the worry of not being able to work leads to frequent insufficient rest or sleep, but frequent insufficient rest or sleep may also lead to inability to work. There may be other issues such as disturbed mental health that may influence ability to work, rest or sleep. Salvail and Liang report on frequent mental distress (FMD)[18] showed the highest FMD prevalence is for adults unable to work. Similarly, Salvail and Smith report on anxiety and depression[19] indicated that highest prevalence of anxiety and depression is for adults unable to work.

Compared to other age groups in the state, the 65 years or older group has the lowest prevalence of frequent insufficient rest or sleep, (12.8%, Table3); yet it has the highest prevalence of frequent unintentional falling asleep (14.4%, Table 4). In addition, the two percentages, (12.8% frequent rest or sleep insufficiency and 14.4% frequent unintentional falling asleep) are statistically similar. These older adults are probably on some medications that cause them to fall

asleep unintentionally, and they are also probably retired and thus have time for rest and sleep (i.e. less likely to experience frequent insufficient rest or sleep). It also naturally follows that frequent insufficient rest or sleep most likely leads to frequent unintentionally falling asleep. However, for younger age groups below 65 years, the pattern does not apply. The prevalence of frequent insufficient rest or sleep for the younger age groups varies from nearly 20% to 33%; yet the corresponding prevalence of frequent unintentional falling asleep is statistically significantly much lower and range from nearly 6% to 9%. Adults under age 65 years may have more resilience or stamina to fight unintentional falling asleep in spite of frequent lack of sleep, a plausible explanation to this pattern.

Research has linked insufficient sleep to increased risk of diabetes[20,21], hypertension[22], coronary heart diseases[10, 23] and obesity[24]. However, the outcome of logistic regression model showed that after adjusting for age, gender, ethnicity, education, employment, and marital status, frequent rest or sleep insufficiency is at best marginally associated with diabetes and coronary heart disease. In addition, the association between obesity, hypertension and sleep insufficiency became insignificant. However, the result of our analysis provides evidence that Hawaii's adults suffering from frequent insufficient rest or sleep are more likely to be impaired in both physical and mental health. Adjusted odds ratios indicate that frequent rest or sleep insufficiency is very strongly associated with serious psychological distress, frequent mental distress and frequent physical distress with AOR above 4 and lower confidence interval above 3. Similarly, the individual AOR for self-perceived poor or fair general health, heart attack, stroke, asthma, chronic obstructive pulmonary disease, high blood cholesterol, arthritis, activity limitation, use of special equipment as it relates to frequent insufficient rest or sleep are significant with AOR above 1 and lower confidence limit above 1. These associations suggest that the state health programs may succeed in reducing the prevalence of these chronic conditions by addressing the lack of sleep. At the minimum, the state may prevent or delay the onset of these health problems and may help alleviate the related problems or symptoms that may accompany the chronic health conditions by promoting sufficient rest and sleep.

Previous research indicates that persons with sleep disorders are likely to engage in adverse health behaviors and report that they are dissatisfied with their life[7,25]. Similarly, our findings

show that among adults in Hawaii, frequent rest or sleep insufficiency is also significantly associated with adverse health behaviors (such as smoking and physical inactivity) and life dissatisfaction indicated by AOR lower limit values above 1. These finding suggest that addressing the lack of sleep may also address the problem of smoking, lack of physical activity and life dissatisfaction.

Our age-adjusted analysis showed that frequent insufficient rest or sleep is strongly associated with frequent unintentional falling asleep as well as drowsy driving, but not associated with snoring. The finding of our study is similar to previous research[26,27] showing that snoring is common among Hawaii adults and is more prevalent in males. Consistent with NCSDR/NHTSA's study[5], our results indicated that males are at a higher risk of drowsy driving than females. This seems to contradict our finding that the prevalence of no days of insufficient rest or sleep is significantly higher for men than for women. Maybe women do not drive when they are sleepy or when not well rested. The prevalence of frequent unintentionally falling asleep for age groups under age 65 years is statistically similar to the prevalence of drowsy driving for the same age groups. But the pattern does not apply for adults 65 year and older (14.5% frequent unintentional falling asleep vs. 2.3% drowsy driving prevalence, Table 4). This may suggest that 65 years or older adults do not drive when they are sleepy or maybe they do not drive at all. The results also suggest that for adults under age 65 years, the derived indicator ***frequent unintentional falling asleep*** from the question "During the past 30 days, for how many days did you find yourself unintentionally falling asleep during the day?" and the question "During the past 30 days, have you ever nodded off or fallen asleep even for just a brief moment while driving" measures the same dimension. It is hoped that other states that field the sleep module will examine this aspect; and if the result is similar, for economy of space in the BRFSS survey, one question may be enough to estimate the possibility of drowsy driving. It is observed that majority (85.6%) of drowsy drivers in Hawaii were employed adults. Many factors may cause a person to experience daytime sleepiness and falling asleep while driving. For employed adults, frequent lack of sleep could be one of the major factors leading to nodding off at work and drowsy driving according to NCSDR/NHTSA's study. As stated earlier, our results showed, frequent insufficient rest or sleep is strongly associated with drowsy driving. Therefore, it is

important to strengthen awareness of the impact of insufficient sleep on public health and public safety.

The findings in this report are subject to several limitations. BRFSS is a land-based random telephone survey of residential households; thus persons without landline telephones (for example those with no telephones or with cellular phones only as well as institutionalized persons) are not represented in the sample. Second, adults with severely impaired physical or mental health might not be able to complete the survey, which might affect our estimates. Third, definitions of "enough" sleep or rest and responses to the survey question were subjective, and the data we analyzed were self-reported and were not validated by any health professionals. Finally, because BRFSS is a cross-sectional survey, no causal relation should be concluded from the study.

The relationship of sleep disorders with many health conditions, chronic health diseases or mental health problems, necessitates collaboration by these programs to incorporate sleep goals in their health promotion activities. The initial activity is to promote awareness of sleep problems in the state of Hawaii, in particular within the health department where the chronic disease programs and mental health programs reside. During the quarterly meeting of April 13, 2010, the findings of this study were presented and were well received. Another activity is planned to present the findings to a wider audience of diverse backgrounds.

Physiologic studies suggest insufficient sleep puts stress on the body, increasing the production of stress hormones, including inflammatory markers which are major risk factors for heart disease, diabetes, stroke, and cancer, and could explain the results of this study. Maybe health care providers, medical practitioners and clinicians can provide initial sleep assessment. Further studies concerning the association of sleep deprivation and health problems are warranted and as more studies conclude with similar results, this could be an important public health and medical intervention in the fight to reduce chronic diseases.

[1] David Castillo. America's Latest Pandemic: 100+ million Americans Suffer From Sleep Problems. Shift Work Disorder News; 2010. Available at http://www.shiftworkdisorder.com/americas-latest-pandemic-100-million-americans-suffer-from-sleep-problems-10804.html

[2] National Sleep Foundation. One-Third of Americans Lose Sleep Over Economy. 2009. Available at http://www.sleepfoundation.org/sites/default/files/2009%20NSF%20POLL%20PRESS%20RELEASE.pdf

[3] Institute of Medicine. Sleep Disorders and Sleep Deprivation: an Unmet Public Health Problem. Washington, DC: The National Academies Press; 2006. Available at http://www.iom.edu/cms/3740/23160/33668.aspx

[4] National Sleep Foundation. 2005. Sleep in America poll: Summary of Findings. Available at http://www.docstoc.com/docs/536744/summary-findings-of-the-2005-sleep-in-america

[5] National Highway Traffic Safety Administration. Drowsy driving and automobile crashes. Available at http://www.nhtsa.dot.gov/people/injury/drowsy_driving1/Drowsy.html

[6] Rosekind et al. The Cost of Poor Sleep: Workplace Productivity Loss and Associated Costs. Journal of Occupational and Environmental Medicine: January 2010:52(1):91-98

[7] Strine TW, Chapman DP. Associations of Frequent Sleep Insufficiency with Health-Related Quality of Life and Health Behaviors. Sleep Med 2005;6:23-7.

[8] Vandeputte M, de Weerd A. Sleep Disorders and Depressive Feelings: A Global Survey with the Beck Depression Scale. SleepMed 2003;4:343–5.

[9] Zimmerman et al. Diagnosing Major Depressive Disorder I: A Psychometric Evaluation of the DSM-IV Symptom Criteria. *J Nerv Ment Dis* 2006;194:158–163.

[10] Kasasbeh et al. Inflammatory Aspects of Sleep Apnea and Their Cardiovascular Consequences. *South Med J* 2006;99:58–67.

[11] Adams PF, Schoenborn CA. Health behaviors of adults: United States, 2002-04. 2006 Sep;(230):1-140.

[12] Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalence and trends in non-specific psychological distress. Psychol Med. 2002; 32:959-76.

[13] Kessler RC, Barker PR, Colpe LJ et al. Screening for serious mental illness in the general population. Arch Gen Psychiatry 2003;60:184–89.

[14]National Sleep Foundation. How Much Sleep Do We Really Need? http://www.sleepfoundation.org/article/how-sleep-works/how-much-sleep-do-we-really-need

[15] Centers for Disease Control and Prevention (CDC). Perceived Insufficient Rest or Sleep—Four States, 2006. MMWR Morb Mortal Wkly Rep. 2008;57(8):200-203.

[16] Centers for Disease Control and Prevention (CDC). Perceived Insufficient Rest or Sleep Among Adults—United States, 2008. MMWR Weekly. October 30, 2009 / 58(42);1175-1179.

[17] McKnight-Eily et al. Perceived Insufficient Rest or Sleep Among Adults—United States, 2008. *JAMA.* 2009;302(23):2532-2539.

[18] Florentina Reyes- Salvail, Shu Liang and Dung-Hanh Nguyen. Frequent Mental Distress Prevalence and Disparity: Hawaii BRFSS 2005 – 2007. http://hawaii.gov/health/statistics/brfss/reports/FMD_rpt_1007.pdf

[19] Florentina R. Salvail and Jeffrey M. Smith. Prevalence of Anxiety and Depression Among Hawaii's Adults Derived from HBRFSS2006. http://hawaii.gov/health/statistics/brfss/reports/Mental_2707rptA.pdf

[20] Knutson et al. Role of Sleep Duration and Quality in the Risk and Severity of Type 2 Diabetes Mellitus. *Arch Intern Med* 2006;166:1768–1764.

[21] Tasali et al. Slow-Wave Sleep and the Risk of Type 2 Diabetes in Humans Proc. Natl. Acad. Sci. USA 2008;105:1044-1049

[22] Gangwisch et al. Short Sleep Duration as a Risk Factor for Hypertension: Analyses of the First National Health and Nutrition Examination Survey. Hypertension. 2006;47(5):833–839.

[23] Miller et al. Invited Review: Inflammation, Sleep, Obesity and Cardiovascular Disease. *Curr Vasc Pharmacol* 2007;5(2): 93-102.

[24] Taheri, S. The Link Between Short Sleep Duration and Obesity: We Should Recommend More Sleep to Prevent Obesity. *Arch Dis Child* 2006;91:881–884.

[25] Strine et al. The Associations Between Life Satisfaction and Health-related Quality of Life, Chronic Illness, and Health Behaviors among U.S. Community-dwelling Adults. J Community Health (2008) 33:40–50

[26] Minal et al. Prevalence of Snoring in College Students. J Am Coll Health. 2008:57(1):45-52.

[27] Sara et al. Frequency of Snoring and Symptoms of Sleep Apnea among Pakistani Medical students. J Ayub Med Coll Abbottabad 2003;15(1)

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