

Original Article

Sleep and society: An epidemiological perspective

Edward Bixler*

Sleep Research and Treatment Center, Penn State University, College of Medicine Hershey, 500 University Dr., Hershey, PA 17033, USA

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ABSTRACT

The relationship between good health and sleep duration has been clearly established in epidemiological studies, although exactly which factors are involved in altering sleep patterns remains to be fully determined. This, at least in part, reflects the complex and multifactorial mechanisms involved in sleep. Subjective sleep duration has slowly declined over the last 50 years, and suboptimal sleep duration and poor sleep quality are becoming widespread in modern society. Suboptimal sleep duration has a strong association with mortality and morbidity; hence there is a need to more clearly understand the mechanisms involved in regulating sleep duration and patterns and to identify high-risk individuals who are in greatest need of preventive strategies. This review focuses on epidemiological evidence of the relationship between sleep duration and various risk factors, including socioeconomic, behavioural and metabolic aspects.

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1. Introduction

Extensive observational and epidemiological evidence indicates that optimal sleep duration of 7–8 h is associated with the maintenance of good health. Changes in sleep duration, whether they result in too little or too much, are associated with a poor health outcome in terms of increases in both morbidity [1–4] and mortality [5–10].

The 1982 Cancer Prevention Study II, which surveyed more than 1 million men in the US, showed that the risk of death increased by more than 15% in those reporting more than 8.5 h of sleep or less than 3.5–4.5 h of sleep [6]. Data from a number of studies indicate that mortality rates increased by 30–50% in individuals sleeping for more than 8 h per day relative to those sleeping for 7–8 h [9].

Since sleep is a pivotal modulator of hormone release, glucose regulation, and cardiovascular function, it is not surprising that changes in sleep duration have a significant impact on morbidity, including increasing the risk of cardiometabolic disorders (such as hypertension [1], metabolic syndrome [1,3] and diabetes mellitus [2]) and affecting neurobehavioral processes (e.g., lapses in attention, slowed working memory, reduced cognitive capacity and depressed mood) [11].

The mechanisms that modulate sleep duration are complex and multifactorial; from an epidemiological perspective, it is important to understand these effects in order to interpret the meaning of the changing trends in subjective sleep duration [7,11,12]. Despite the

known health risks associated with a suboptimal amount of sleep, evidence suggests that the average self-reported duration of sleep has declined during the latter half of the last century, with many 8-h sleepers now sleeping ≤ 7 h [7,13]. Indeed, based on trends of self-reported sleep duration and insomnia-related symptoms from a Finnish study conducted between 1972 and 2005, there was an approximately 18-min reduction in sleep duration during this 33-year period and an increase in sleep complaints, particularly amongst middle-aged males [7]. In American adults and adolescents, sleep duration declined by 1.5–2 h over the last 50 years [4].

Reduced sleep duration and sleep quality are common in modern society. Subjective sleep duration of <6 h was reported by $>30\%$ of 30–64-year-old Americans [4]. Based on data from the 2004–2006 National Health Institute Survey (NHIS), chronic sleep loss and sleep disorders are estimated to affect 70 million Americans [14].

It remains to be fully determined whether reductions in sleep duration are a reflection of changes in modern lifestyle (e.g., late-night diversions such as the internet and television and longer working hours) and/or other factors, but most likely they reflect a complex combination of numerous individual and health-related factors.

The principal factors linked to suboptimal sleep duration discussed in this review are:

- socioeconomic status,
- behavioural and lifestyle factors such as smoking, alcohol consumption and physical inactivity/obesity,
- sleep complaints and stress,
- age-related factors.

* Tel.: +1 717 531 5556; fax: +1 717 531 6491.

E-mail address: ebixler@psu.edu

2. Sleep duration and socioeconomic status

The socioeconomic environment has a potentially important influence on sleep duration [8–10]. For instance, based on data collected over a 34-year period from residents of Alameda County in California, a low socioeconomic status was shown to be a strong predictor of short sleep duration (<7 h/night), with suboptimal sleep duration being most frequent among those with lower incomes and lower educational levels and among race/ethnicity groups such as African-Americans and Hispanics (Fig. 1) [10]. The age-adjusted odds of short sleep duration increased in African-Americans (odds ratio [OR] 1.97 vs. Caucasians; 95% CI 1.68–2.30) in the lowest household income quintile (OR 1.62 vs. highest quintile; 95% CI 1.34–1.94) and among those with less than high-

school education (OR 1.51 vs. those with more than high-school education; 95% CI 1.30–1.75). Moreover, this association occurred even after adjustment for health-related characteristics that are linked to short sleep duration, including depression and other chronic health conditions. Longitudinal analysis showed an increase in short sleep duration over time for all subgroups when stratified for income, education and race/ethnicity (Fig. 1). The rate of increase over time was broadly similar across income and education strata. In contrast, there were marked differences in the rates of increase for different race/ethnicity groups, with a significantly higher rate of increase over time for African-American and Hispanic individuals than for Caucasian Americans [10].

Living conditions and other factors associated with socioeconomic status were the strongest potential mediators of short sleep

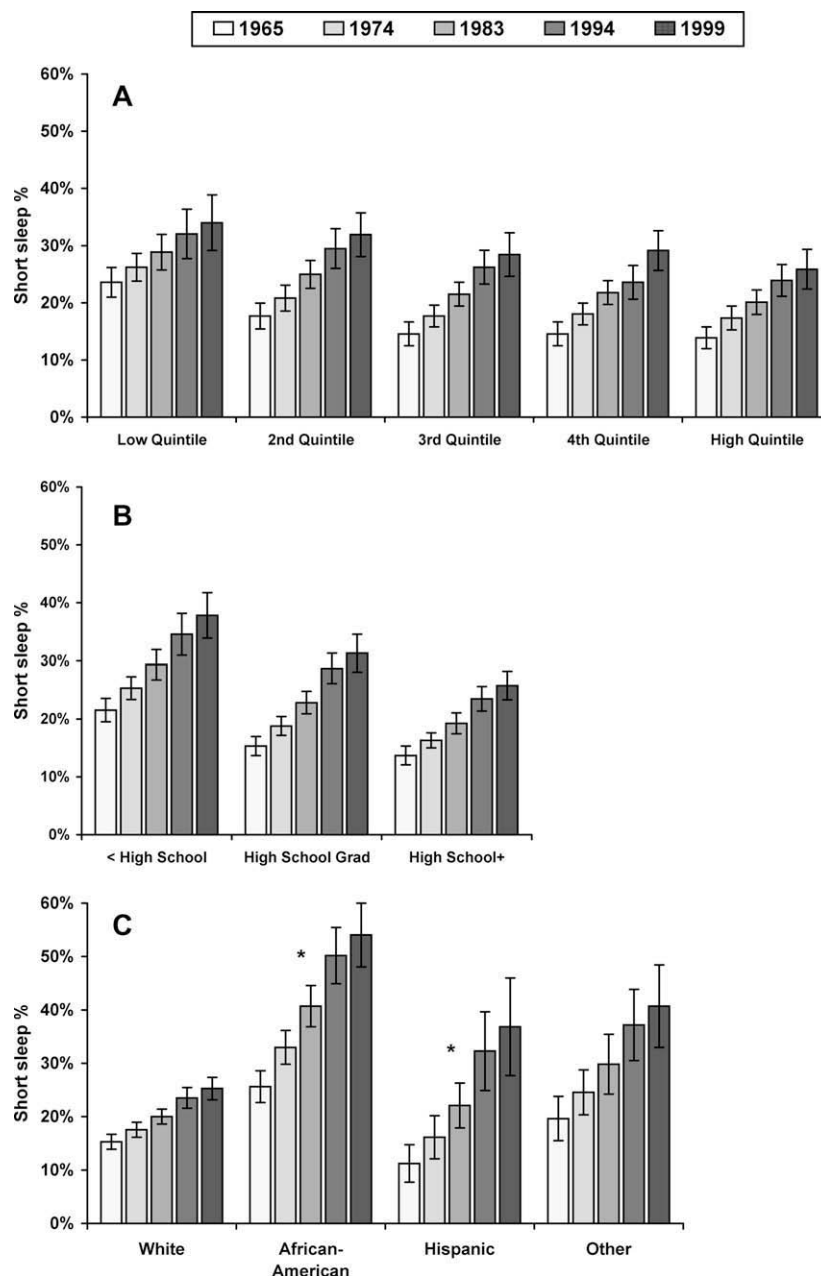


Fig. 1. Age-adjusted mean probability ($\pm 95\%$ confidence interval) of short sleep duration over time based on (A) household income quintile, (B) education level, and (C) race/ethnic group for participants in the Alameda County Health and Ways of Living Study, 1965–1999 [10]. $P < 0.0001$ for increase over time in the probability of short sleep duration vs. Caucasian American participants. Reprinted from *Annals of Epidemiology*, vol. 17, Stamatakis KA, et al. Short sleep duration across income, education, and race/ethnic groups: population prevalence and growing disparities during 34 years of follow-up. p. 948–55.

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