Sleep and Breathing (2020) 24:357–367
https://doi.org/10.1007/s11325-019-01833-3

EPIDEMIOLOGY • ORIGINAL ARTICLE

Sleepless in Beirut: sleep duration and associated subjective sleep insufficiency, daytime fatigue, and sleep debt in an urban environment

Hassan A. Chami[1] · Blanche Ghandour[1] · Hussain Isma'eel[1] · Lara Nasreddine[2] · Mona Nasrallah[1] · Hani Tamim[1]

Received: 7 November 2018 / Revised: 6 February 2019 / Accepted: 21 March 2019 / Published online: 27 April 2019

Abstract

Purpose Insufficient sleep is not well studied in developing countries. We assessed sleep duration among adults in Lebanon and examined its potential predictors and relationship with subjective sleep insufficiency, daytime fatigue, and weekday sleep debt.

Methods This cross-sectional study included 501 adults (mean age 45.2 (SD15.2) years, 64% females) from the community in Beirut and Mount Lebanon. Socio-demographic, lifestyle and health characteristics, subjective sleep insufficiency, daytime fatigue, and weekday sleep debt (weekend vs. weekdays sleep duration) were compared between individuals who reported sleeping < 6:00, 6–7:59(reference), or ≥ 8:00 h/night. Symptoms and predictors of sleep duration were assessed using logistic regression.

Results Thirty-nine percent of participants reported sleeping < 6 h/night while 15% reported sleeping ≥ 8:00 h/night. Age (OR = 1.16/year, 95% CI [1.02–1.33]) and female sex (OR = 1.71, 95% CI [1.14–2.58]) were significant predictors of short sleep (< 6:00 h/night) in multivariable adjusted analyses. Compared to referent (6:00–7:59 h/night) and long sleepers (≥ 8:00 h/night), short sleepers were significantly more likely to report subjective sleep insufficiency (OR = 3.00, 95% CI [2:00–4.48], and OR = 4.52, 95% CI [2.41–8.51]; respectively) and daytime fatigue (OR = 1.53, 95% CI [1.04–2.24], and OR = 1.83, 95% CI [1.06–2.04]; respectively). Compared to long weekdays sleepers, short and referent weekdays sleepers were more likely to sleep longer on weekend (OR = 2.47, 95% CI [1.18–5.15], and OR = 4.16, 95% CI [2.03–8.5]; respectively).

Conclusions Short sleep is highly prevalent in this urban cohort from a low- to medium-income country especially among women and older adults, and is associated with subjective sleep insufficiency, daytime fatigue, and weekday sleep debt. The socio-cultural determinants of sleep duration need to be studied across different populations to better evaluate the causes and implications of short sleep.

Keywords Sleep duration · Short sleep · Sleep duration predictors · Epidemiology

Introduction

Short sleep duration of less than 6 h per night has been associated with multiple adverse health consequences including prevalent and incident obesity, type-2 diabetes, cardiovascular diseases, and mortality [1–3]. Conversely, extending sleep duration in chronically sleep-deprived adults was associated with improved insulin sensitivity [4] and with blood pressure reduction in pre-hypertensive and hypertensive adults [5].

The prevalence of short sleep varies between reports from different countries ranging from 3% when defined as < 6 h in Australia [6] to 25% when defined as ≤ 6 h in samples from the USA [7]. Although the difference in short sleep prevalence could be due to the different cutoffs used, sleep duration also varies among racial/ethnic groups and is influenced by socio-economic, ecologic, cultural, and lifestyle factors [8]. A socio-ecological model on the determinants of sleep suggests that sleep behaviors are influenced by the interactions of individuals and their surrounding physical and social environments [1]. Indeed, unemployment, high stress level, living in disadvantaged neighborhoods, and having a low socio-economic status were associated with shorter sleep duration in the

✉ Hani Tamim
htamim@aub.edu.lb

[1] Department of Internal Medicine, American University of Beirut Medical Center, Riad El Solh, Beirut 11-0236, Lebanon

[2] Department of Nutrition and Food Sciences, Faculty of Agricultural and Food Sciences, American University of Beirut, Beirut, Lebanon

USA and the UK [7, 9]. While in Norway, short sleep was associated with single marital status, urban living, and with low education status among males [10].

In Lebanon, data regarding sleep habits and duration in the general Lebanese adult population is lacking. Prior studies evaluated Lebanese University students aged between 18 and 25 years old [11, 12]. One study reported an average sleep duration of 6:40 h among 735 students and a high prevalence of poor sleep quality (53%) [11], whereas another study reported an average sleep duration of 7:58 h among 540 university students, of whom 12% reported sleeping 6:30 h [12]. The latter study also reported poor sleep quality among 59% of the studied group associated with reduced sleep duration and variable sleep timing between weekdays and weekends.

This study aimed to assess sleep duration and examine its socio-demographic, lifestyle, and health predictors and its relationship with subjective sleep insufficiency, daytime fatigue, and weekday sleep debt in an urban sample of the Lebanese population residing in Greater Beirut.

Materials and methods

Study design and sample size

This cross-sectional study was conducted between March and May 2014 as part of the Greater Beirut Area Cardiovascular Cohort, a prospective observational study among a sample of the Lebanese adults from Greater Beirut and its suburbs. Participants were recruited by trained personnel, using previously reported door-to-door sampling methods and procedures [13]. A random area multistage probability sampling was performed, stratified by the districts of Greater Beirut. Neighborhoods inside each district were selected; then, households were selected in each neighborhood using systematic random sampling according to the estimated number of buildings in the neighborhood. Finally, adults aged between 18 and 70 years old were identified within each household and the primary respondent was selected based on the most recent birthday.

Five hundred and one men and women were enrolled. Individuals who work in plastic or chemical industry were excluded to allow assessment of environmental chemicals exposure in this cohort. Pregnant and lactating females, individuals on dialysis, or with diagnosed psychiatric disorders were also excluded from the study. All study procedures were conducted at the American University of Beirut (AUB). The AUB institutional review board approved the study (IM.HT.03). Informed consent was obtained from all participants.

Data collection and variable specification

Sleep duration, weekday sleep debt, subjective sleep insufficiency, and daytime fatigue

Sleep duration, subjective sleep insufficiency, and daytime fatigue were assessed using Arabic translations of the Sleep Heart Health Study (SHHS) [14] and Berlin questionnaires [15] that were administered during a face-to-face interview at AUB. The SHHS questionnaire was translated to Arabic by a team of local experts, then back-translated to English and the discrepancies between translations were resolved; then, the questionnaire was piloted prior to initiating the study. The Arabic translation of the Berlin questionnaire was previously validated [15].

Usual sleep duration was assessed using the questions "how many hours do you usually sleep during weekdays?" and "how many hours do you usually sleep during weekends?" from the SHHS questionnaire. Responses were integer values. Usual sleep duration was calculated by adding self-reported usual weekday sleep duration multiplied by 5 to the number of self-reported usual weekend sleep duration multiplied by 2 and dividing the total by 7. The stability of self-reported sleep time has been previously demonstrated [16]. Sleep duration was categorized into < 6:00 h, 6:00–7:59 h, or ≥ 8:00 h. Short sleep duration was defined as usual sleep duration less than 6:00 h per night [3].

Weekday sleep debt was estimated as the difference in reported sleep duration between weekdays and weekends [17], with the assumption that individuals who curtail sleep during weekdays for work or school schedule and social commitments may have the opportunity to sleep longer on weekends.

Subjective sleep insufficiency was assessed using the question "do you feel that you are not getting enough sleep?" from the SHHS questionnaire [14]. Daytime fatigue was assessed using items 6 and 7 of the Berlin questionnaire: "how often do you feel tired or fatigued after you sleep?" and "during your waking time do you feel tired, fatigued or not up to par?" [15].

Response options on the Berlin questionnaire were nearly every day, 3–4 times per week, 1–2 times per week, 1–2 times per month, never, or nearly never. For analysis, these responses were lumped into two categories: comprising the responses nearly every day and 3–4 times per week; or comprising the remaining options. In the SHHS questionnaire, response options were almost always (16–30 times per month), often (5–15 times per months), sometimes (2–4 times per month), rarely (1 time per month), and never. For analysis, the responses were collapsed into two categories comprising the response almost always or comprising all other responses.

Sample characteristics

Characteristics of the study sample were assessed using an investigator-administered questionnaire, during a face-to-face interview at AUB. Demographic and socioeconomic characteristics included age at the time of the interview, sex, education level (below high school/high school/university), employment status (employed/unemployed), and monthly income (< 1000$/≥ 1000$). Health behaviors were also assessed including current smoking status and alcohol and caffeine consumption. Dietary intake was assessed using a questionnaire that estimated the amount and frequency of consumption of 80 food items [18]. The daily energy and macronutrient intake levels were then computed using the Nutritionist Pro Software (Axxya Systems LCC 2016, Nutritionist Pro™ version 6.3.0. Stafford). Physical activity was assessed using the Arabic short version of the International Physical Activity Questionnaire (IPAQ) and the level of physical activity determined as low, moderate, and high intensity based on the calculated METS-min per week following IPAQ criteria [19]. Medical history included presence of hypertension, arthritis, diabetes, dyslipidemia, thyroid disease, coronary artery disease, chronic bronchitis or emphysema, liver disease, cancer, and stroke. Height, weight, and blood pressure were measured at the time of the visit.

Statistical analyses

Sample characteristics were summarized using means and standard deviations for continuous variables and frequency and percentages for categorical variables and are presented for the whole sample and stratified by sex. Frequency of weekdays, weekends and usual sleep duration categories (< 6:00 h, 6:00–7:59 h, or ≥ 8:00 h), subjective sleep insufficiency, and fatigue are presented for the total sample and stratified by sex and by age categories. Characteristics were compared between sex and age categories using chi-square test for categorical variables and *t* test for continuous variables.

Sample characteristics are also presented stratified by usual sleep duration (< 6:00 h, 6:00–7:59 h, or ≥ 8:00 h). Multinomial logistic regression was used to assess the predictors of usual sleep duration. The dependent variable for the main analysis was usual sleep duration treated as a categorical variable (< 6:00 h, 6:00–7:59 h (reference), or ≥ 8:00 h). Odds ratio (OR) and a 95% confidence interval (CI) are presented unadjusted and adjusted for age and sex. Multivariable regression models adjusted for all significant bivariate predictors of sleep duration in our sample are also reported.

Frequency of subjective sleep insufficiency and fatigue are also presented stratified by usual sleep duration, while the variability in sleep duration between weekend and weekdays is presented stratified by weekdays sleep duration. Logistic regression was used to assess the association between sleep duration (independent variable) and subjective sleep insufficiency, fatigue, and variability in sleep duration between weekend and weekdays (dependent variables).

OR and 95% CI are presented unadjusted and adjusted for age, sex, and their interaction term (age × sex). p value < 0.05 was considered to be statistically significant. All analyses were performed using SPSS Statistical Software for Windows (IBM SPSS Version 21, Chicago, Illinois, USA).

Results

A total of 501 adults residing in Greater Beirut completed the questionnaires. The mean age of participants was 45.4 (SD 15.0) years, 64% were females and 63.7% did not complete high-school (Table 1). Approximately half of the respondents (53.7%) reported being unemployed and 71.3% reported a family income below 1000$ per month. Sixty-four percent of the respondents reported current smoking, 19% reported drinking alcohol, 80.4% consumed caffeinated beverages, and 47.7% reported a low-intensity physical activity. The average body mass index (BMI) was 29.1 kg/m^2 (SD 5.8) and 45% of participants were obese (BMI > 30 kg/m^2).

In total, 39.1% of the participants reported sleeping < 6 h/night while 15% reported sleeping 8 h or more (Table 2). Furthermore, 46.6% of participants reported daytime fatigue 3–7 days per week and 36.1% reported feeling of not getting enough sleep almost always. Finally, 29.5% of participants reported sleeping longer hours on weekends compared to weekdays. Indeed, the proportion of individual who slept 8 h or more was significantly higher on weekends compared to weekdays (29.3% vs. 15.6% $p < 0.001$) while the proportion of individuals who slept < 6 h/night was lower on weekends compared to weekdays (31.3 vs. 39.7% $p < 0.001$).

The prevalence of short sleep (< 6 h/night) was significantly higher in females compared with males (43.2 vs. 31.8% $p = 0.01$), both during weekdays and during weekends. Similarly, compared with males, females were more likely to report daytime fatigue (53 vs. 34% $p < 0.001$) and the feeling of not getting enough sleep (39 vs. 31% $p = 0.001$), and were less likely to sleep longer on weekends vs. weekdays (25.2 vs. 37.4% $p = 0.01$). Shorter sleep duration was more prevalent among older participants especially during weekends; however, a similar trend of increased prevalence of short sleep duration in older individuals during weekdays was not statistically significant possibly due to insufficient statistical power (Table 3).

Short sleep duration was significantly associated with female sex (OR = 1.84, 95% CI [1.23–2.76]; $p = 0.01$), older age (OR = 1.02/year, 95% CI [1.02–1.03]; $p = 0.01$), and with lower alcohol (OR = 0.52, 95% CI [0.31–0.87]; $p = 0.01$) and lower calorie consumption (OR = 0.85, 95% CI [0.75–0.97];

$p = 0.01$) in bivariate regression analyses but not in analyses adjusted for age and sex (Table 4). Similarly, when all significant bivariate predictors of short sleep duration were included in a multivariable regression model, only older age (OR = 1.16/year, 95% CI [1.02–1.33]; $p = 0.03$) and females sex (OR = 1.71, 95% CI [1.14–2.58]; $p = 0.01$) remained significant predictors of short sleep duration. Unemployment and physical inactivity were significant predictors of long sleep in multivariable adjusted analyses (OR = 2.00, 95% CI [1.16–3.44]; $p = 0.01$ and OR = 1.78, 95% CI [1.05–3.04]; $p = 0.03$, respectively). While diabetes and physical inactivity were significantly associated with longer sleep duration in analyses adjusted for age and sex.

Linear trend for higher mean BMI that did not reach statistical significance was noted in short sleeper compared to normal and long sleepers (29.7 vs. 29.0 and 28.0 kg/m^2, respectively). Similar trends for higher prevalence of coffee drinking in short sleeper compared to normal and long sleepers (84.7 vs. 79.1 and 73.3%, respectively) and for higher prevalence of arthritis (22.4 vs. 15.7 and 9.3%, respectively) were also noted.

Short sleepers were more likely to report subjective sleep insufficiency compared to referent (OR = 3.00, 95% CI [2:00–4.48]; $p < 0.001$) and long sleepers (OR = 4.52, 95% CI [2.41–8.51]; $p < 0.0001$, Table 5). Short sleepers were also more likely to report daytime fatigue compared to referent (OR = 1.53, 95% CI [1.04–2.24]; $p = 0.03$) and long sleepers (OR = 1.83, 95% CI [1.06–2.04]; $p = 0.03$). Finally, short and referent weekday sleepers were more likely to report sleeping longer on weekends compared to

Table 1 Demographic, lifestyle, and health characteristics ($N = 501$)

s **Characteristics**	Total sample $n = 501$	Male $n = 179$ (36%)	Female $n = 322$ (64%)	p value[a]
Age (years), mean (SD)	45.4 (15.0)	41.9 (16.4)	47.3 (13.8)	**< 0.001**
Highest education, *n* (%)				**< 0.001**
Below high school	317 (63.7)	93 (52.2)	224 (70.0)	
High school	127 (25.5)	66 (37.1)	61 (19.1)	
Above high school	54 (10.8)	19 (10.7)	35 (10.9)	
Unemployed, *n* (%)	269 (53.7)	21 (11.7)	248 (77.0)	**< 0.001**
Family Income < 1000$/month, *n* (%)	323 (71.3)	109 (64.9)	214 (75.1)	**0.02**
Body-mass index (kg/m^2), mean (SD)	29.1 (5.8)	28.0 (5.2)	29.7 (6.01)	**0.002**
Post-menopause, *n* (%)	–	–	149 (46.3)	–
Health behaviors				
Current smoker, *n* (%)	322 (64.3)	128 (71.5)	194 (60.2)	**0.01**
Currently drink alcohol, *n* (%)	95 (19.0)	74 (41.3)	21 (6.5)	**< 0.001**
Currently drink coffee, *n* (%)	403 (80.4)	137 (76.5)	266 (82.6)	0.1
Low intensity physical activity, *n* (%)	239 (47.7)	83 (46.4)	156 (48.4)	0.6
Dietary habits				
Energy intake/day (Kcal), mean (SD)	3320.0 (1594.2)	4350.4 (1738.8)	2791.9 (1215.6)	**< 0.001**
Proteins intake/day (g/dl), mean (SD)	101.4 (50.2)	136.4 (53.86)	83.5 (37.2)	**< 0.001**
Carbohydrates intake/day (g/dl), mean (SD)	381.1 (178.2)	489.3 (188.2)	324.7 (143.7)	**< 0.001**
Fat intake/day (g/dl), mean (SD)	155.7 (85.3)	204.0 (94.7)	129.7 (66.8)	**< 0.001**
Health characteristics				
Systolic blood pressure (mmHg), Mean (SD)	121.9 (19.3)	127.1 (18.9)	119.0 (19.0)	**< 0.001**
Diastolic blood pressure (mmHg), mean (SD)	75.3 (10.2)	79.2 (9.8)	73.2 (9.8)	**< 0.001**
Hypertension, *n* (%)	119 (23.8)	34 (19)	85 (26.4)	0.06
Dyslipidemia, *n* (%)	120 (24)	34 (19)	86 (26.7)	0.053
Arthritis, *n* (%)	87 (17.4)	13 (7.3)	74 (23)	**< 0.001**
Thyroid disease, *n* (%)	60 (12)	2 (1.1)	58 (18)	**< 0.001**
Diabetes, *n* (%)	64 (12.8)	19 (10.6)	45 (14)	0.3
Other diseases[b], *n* (%)	69 (13.8)	19 (10.6)	50 (15.5)	0.1

Bold entries correspond to significant p-value <0.05

[a] Characteristics are compared between males and females using chi-square test for categorical variables and t test for continuous variables

[b] Other diseases include coronary artery disease ($n = 22$), chronic bronchitis or emphysema ($n = 26$), liver disease ($n = 14$), cancer ($n = 8$), or stroke ($n = 7$)

Table 2 Sleep duration and daytime fatigue among males and females ($N = 501$)

Sleep duration and daytime symptoms	Total sample $n = 501$	Male $n = 179$	Female $n = 322$	p value[a]
Sleep duration on weekdays, n (%)				**0.05**
Less than 6:00 h/night	199 (39.7)	62 (34.6)	137 (42.5)	
6:00–7:59 h/night	224 (44.7)	93 (52.0)	131 (40.7)	
8:00 h or more/night	78 (15.6)	24 (13.4)	54 (16.8)	
Sleep duration on weekends, n (%)				**0.02**
Less than 6:00 h/night	157 (31.3)	43 (24.0)	114 (35.4)	
6:00–7:59 h/night	197 (39.3)	74 (41.3)	123 (38.2)	
8:00 h or more/night	147 (29.3)	62 (34.6)	85 (26.4)	
Usual sleep duration[b], n (%)				**0.01**
Less than 6:00 h/night	196 (39.1)	57 (31.8)	139 (43.2)	
6:00–7:59 h/night	230 (45.9)	99 (55.3)	131 (40.7)	
8:00 h or more/night	75 (15.0)	23 (12.8)	52 (16.1)	
Subjective sleep insufficiency[c], n (%)	177 (36.1)	54 (30.7)	123 (39.2)	**0.001**
Post-awakening fatigue[d], n (%)	232 (46.6)	65 (36.5)	167 (52.2)	**0.001**
Daytime fatigue[d], n (%)	233 (46.6)	61 (34.3)	172 (53.4)	**0.001**
Weekends vs. weekdays sleep, n (%)				**< 0.001**
Sleep less on weekends	19 (3.8)	6 (3.4)	13 (4.0)	
Same sleep duration on weekends	334 (66.7)	106 (59.2)	228 (70.8)	
Sleep longer on weekends	148 (29.5)	67 (37.4)	81 (25.2)	

Bold entries correspond to significant p-value <0.05

[a] Sleep duration categories and daytime fatigue are compared between males and females using chi-square test for difference in proportion

[b] Weighted average of weekend and weekdays sleep duration

[c] Almost always (16 to 30 times per month)

[d] Nearly every day or 3–4 times a week

long weekday sleepers (OR = 2.47, 95% CI [1.18–5.15]; $p = 0.02$ and OR = 4.16, 95% CI [2.03–8.51]; $p < 0.001$, respectively), but short sleepers were less likely to sleep longer on weekend compared with referent sleepers (OR = 0.59, 95% CI [0.39–0.9]; $p = 0.01$). Results were similar in analyses adjusting for age and sex.

Discussion

This is the first study to evaluate sleep duration in an adult community-based sample from Lebanon, a small, low- to medium-income Middle Eastern country on the eastern Mediterranean with an estimated 5 million inhabitants. This study suggests that short sleep duration is highly prevalent among the urban Lebanese population of Greater Beirut with 39% of participants reporting sleeping < 6:00 h per night. While older age and female sex were significant independent predictors of short sleep duration, short sleep duration was associated with the subjective perception of sleep insufficiency, daytime fatigue, evidence of a sleep debt (longer sleep duration on the weekends), and a trend for higher caffeine consumption suggesting that sleep is insufficient.

The prevalence of short sleep in our sample (39%) from a low- to medium-income country is strikingly higher than what was previously reported in various cohorts primarily from developed countries. In these cohorts, the prevalence of short sleep ranged from 3% when defined as < 6 h, in a sample from New South Wales in Australia (age ≥ 45 years, 53% females) [6], 4.5% when defined as < 6.5 h in Japan (age 40–79 years, 58% females) [20], 10.5% when defined as ≤ 5 h in Shanghai, China (age 40–79 years, 60% females) [21], 15% when defined as ≤ 5 h, in South Korea, (age 19–59 years, 47% females) [22], and up to 25% when defined as ≤ 6 h in the USA (mean age 43 years, 52% females) [7]. Conversely, the prevalence of short sleep defined as < 7 h was higher at 34% in a sample from Saudi Arabia (average age 34, 40% females), a country that is close geographically and that shares some cultural similarities with Lebanon including the Arabic language [23]. Age and sex distribution of the study population and the cutoff used to define short sleep duration are important determinant of sleep duration and vary among these cohorts. However, it is unlikely that the sizable difference in the prevalence of short sleep between these cohorts from various countries is solely attributed to differences in age and sex distribution in these cohorts and the short sleep

Table 3 Sleep duration and daytime fatigue among different age group ($N = 501$)

	Age groups (years)						
	18.0–25.9 (reference) $n = 73$	26.0–48.3		48.4–64.9		≥ 65.0	
		$n = 190$	p value[a]	$n = 190$	p value[a]	$n = 48$	p value[a]
Sleep duration on weekdays, *n (%)*			0.08		0.07		0.16
Less than 6:00 h/night	21 (28.8)	77 (40.5)		79 (41.6)		22 (45.8)	
6:00–7:59 h/night	35 (47.9)	87 (45.8)		85 (44.7)		17 (35.4)	
8:00 h or more/night	17 (23.3)	26 (13.7)		26 (13.7)		9 (18.8)	
Sleep duration on weekends, *n* (%)			**0.004**		**< 0.0001**		**0.03**
Less than 6:00 h/night	15 (20.5)	55 (28.9)		69 (36.3)		18 (37.5)	
6:00–7:59 h/night	21 (28.8)	80 (42.1)		79 (41.6)		17 (35.4)	
8:00 h or more/night	37 (50.7)	55 (28.9)		42 (22.1)		13 (27.1)	
Average daily sleep duration, *n* (%)			**0.05**		**0.04**		0.07
Less than 6:00 h/night	19 (26.0)	77 (40.5)		78 (41.1)		22 (45.8)	
6:00–7:59 h/night	38 (52.1)	88 (46.3)		87 (45.8)		17 (35.4)	
8:00 h or more/night	16 (21.9)	25 (13.2)		25 (13.2)		9 (18.8)	
Subjective sleep insufficiency[b], *n* (%)	23 (32.9)	78 (41.5)	0.46	58 (31.2)	0.94	18 (39.1)	0.59
Post-awakening fatigue[c], *n* (%)	31 (42.5)	95 (50.8)	0.23	81 (42.6)	0.98	25 (52.1)	0.30
Daytime fatigue[c], *n* (%)	29 (39.7)	92 (48.7)	0.19	86 (45.3)	0.42	26 (54.2)	0.12

Bold entries correspond to significant p-value <0.05

[a] Sleep duration categories and daytime fatigue are compared with the referent age group (18–25.9 years) using chi-square test for difference in proportion

[b] Almost always (16 to 30 times per month)

[c] Nearly every day or 3–4 times a week

duration cutoffs/definition used. Indeed, the reported prevalence of short sleep duration was higher in Shanghai, China [21], compared to Japan [20], although the cutoff for short sleep duration was more restrictive in the study from China (≤ 5 vs. < 6.5 h respectively). Difference in socio-economic, lifestyle, and cultural factors and local attitudes towards sleep are likely to be implicated as well [8]. In a study on 38,000 Lebanese Australians, for example (average age 34, 48% females), those of Lebanese ethnicity born in Lebanon had a lower lifestyle index score on average compared to those of Australian ethnicity [24]. This was manifested as not meeting the physical activity guidelines, smoking, and suboptimal sleep conditions and sleep debt in up to 20% of the population.

The association of short sleep with daytime fatigue is consistent with studies that examined the effect of sleep restriction on sleepiness and suggests that this short sleep duration (< 6:00 h/night) is indeed insufficient rather than a normal trait of the local population. About 30% of the sample reported longer sleep duration on weekends suggesting the presence of a significant sleep debt during weekdays associated with weekdays work and school schedules or social commitments. However, since the majority of weekday short sleepers do not report sleeping longer on weekends, other socio-economic and local cultural and mental health factors not associated with variability in sleep duration between weekends and weekday could also be implicated. For example, weekend social demands and late evening meals, which are known to be part of the local Lebanese and Middle Eastern customs, could curtail sleep on weekends. Issues of noise pollution, crowded living, and co-sleeping could contribute as well [8].

Furthermore, the high level of unemployment could attenuate the association between short sleep and weekday sleep debt [9]. Finally, although individuals with self-reported mental health disorders were excluded from this study, the high prevalence of undiagnosed anxiety and depression among the Lebanese population could also contribute to the high prevalence of both weekday and weekend short sleep in this sample. Indeed, 16.7% of the Lebanese population is estimated to suffer from anxiety disorder and 12.6% from a mood disorder [25].

The finding of a high prevalence of short sleep duration in our population is important as short sleep duration was associated with daytime fatigue in our sample. Furthermore, sleep duration of < 6:00 h/night has been previously associated with multiple adverse health outcomes [1–3]. We observed the previously described U-shaped association between sleep duration and health

Table 4 Association of demographic, health behaviors, and health characteristics with sleep duration ($N = 501$)

	N (%)			Unadjusted analysis				Adjusted analysis[b]			
	Short sleep < 6:00 h/night	Referent sleep 6:00–7:59 h/night	Long sleep ≥ 8:00 h/night	Short vs. referent sleep duration		Long vs. referent sleep duration		Short vs. referent sleep duration		Long vs. referent sleep duration	
Characteristic	*N* = 196	*N* = 230	*N* = 75	OR (95%CI)	p	OR (95% CI)	p	OR (95%CI)	p	OR (95%CI)	p
Females, *n* (%)	139 (70.9)	131 (57.0)	52 (69.3)	1.84 (1.23–2.76)	**0.01**	1.71 (0.98–2.98)	0.06	1.71 (1.14–2.58)	**0.01**	1.71 (0.98–2.98)	0.06
Age (years), mean (SD)	47.7 (14.2)	43.8 (15.0)	44.2 (16.5)	1.02 (1.01–1.03)	**0.01**	1.00 (0.99–1.02)	0.8	1.02 (1.00–1.03)	**0.03**	1.00 (0.98–1.02)	0.9
Highest education, *n* (%)											
Below high school	132 (67.7)	134 (58.8)	51 (68.0)	1.43 (0.96–2.12)	0.08	1.47 (0.85–2.55)	0.2	1.15 (0.75–1.76)	0.5	1.39 (0.75–2.50)	0.3
High school	43 (22.1)	67 (29.4)	17 (22.7)	0.70 (0.45–1.09)	0.1	0.71 (0.39–1.31)	0.3	0.87 (0.55–1.38)	0.9	0.79 (0.43–1.48)	0.47
Above high school	20 (10.3)	27 (11.8)	7 (9.3)	0.85 (0.46–1.58)	0.6	0.77 (0.32–1.86)	0.6	0.97 (0.51–1.82)	0.9	0.75 (0.32–1.85)	0.5
Unemployed, *n* (%)	110 (56.1)	110 (47.8)	49 (65.3)	1.40 (0.95–2.05)	0.09	2.06 (1.20–3.53)	**0.01**	0.89 (0.54–1.46)	0.6	1.94 (0.96–3.94)	0.07
Family income < 1000$/month, *n* (%)	131 (74.9)	150 (71.1)	42 (62.7)	1.21 (0.77–1.91)	0.4	0.68 (0.38–1.22)	0.2	1.01 (0.63–1.63)	0.9	0.64 (0.36–1.15)	0.1
Body mass index (kg/m^2), mean (SD)	29.7 (6.1)	29.0 (5.6)	28.0 (5.4)	1.02 (0.99–1.06)	0.2	0.97 (0.92–1.02)	0.2	1.02 (0.98–1.05)	0.4	0.96 (0.92–1.01)	0.1
Post-menopause, *n* (%) females	67 (48.2)	59 (45.0)	23 (44.2)	1.14 (0.70–1.83)	0.6	0.97 (0.51–1.85)	0.9				
Health behaviors											
Current smoker, *n* (%)	124 (63.3)	152 (66.1)	46 (61.3)	0.88 (0.59–1.32)	0.5	0.81 (0.48–1.40)	0.4	1.06 (0.70–1.61)	0.8	0.85 (0.49–1.49)	0.6
Currently drinking alcohol, *n* (%)	27 (13.8)	54 (23.5)	14 (18.7)	0.52 (0.31–0.87)	**0.01**	0.75 (0.39–1.44)	0.4	0.74 (0.42–1.32)	0.3	0.98 (0.46–2.07)	0.9
Currently drinking coffee, *n* (%)	166 (84.7)	182 (79.1)	55 (73.3)	1.46 (0.88–2.41)	0.1	0.73 (0.40–1.33)	0.3	1.27 (0.76–2.13)	0.4	0.69 (0.38–1.27)	0.2
Low intensity physical activity, *n* (%)	95 (48.5)	100 (56.5)	44 (58.7)	1.22 (0.83–1.79)	0.3	1.85 (1.09–3.13)	**0.02**	1.15 (0.78–1.70)	0.5	1.86 (1.09–3.18)	**0.02**
Dietary habits											
Energy intake/day (Kcal), mean (SD)	3098(1567)	3486(1573)	3390(1679)	0.85 (0.75–0.97)	**0.01**	0.97 (0.82–1.14)	0.7	0.95 (0.82–1.10)	0.5	1.05 (0.87–1.26)	0.6
Proteins intake/day (g/dl), mean (SD)	96.8 (52.7)	106.1 (48.1)	99.5 (49.3)	0.69 (0.46–1.02)	0.06	0.77 (0.45–1.32)	0.35	0.99 (0.62–1.59)	1.0	0.77 (0.45–1.32)	0.3
Carbohydrates intake /day(g/dl), mean (SD)	358.7 (179.6)	398.8 (170.4)	384.6 (193.7)	0.88 (0.79–0.98)	**0.02**	0.96 (0.83–1.11)	0.56	0.97 (0.85–1.10)	0.6	0.99 (0.52–1.86)	1.0
Fat intake/day(g/dl), mean (SD)	145.4 (85.0)	163.5 (84.8)	158.6 (86.1)	0.77 (0.61–0.98)	**0.03**	0.94 (0.69–1.27)	0.67	0.93 (0.72–1.22)	0.6	1.06 (0.75–1.49)	0.76
Health characteristics											
Systolic blood pressure (mmHg), mean (SD)	122.4 (20.4)	122.6 (17.9)	118.4 (20.7)	1.00 (0.99–1.01)	0.9	0.99 (0.97–1.00)	0.1	1.00 (0.99–1.01)	0.7	0.99 (0.98–1.01)	0.2
Diastolic blood pressure (mmHg), mean (SD)	74.9 (10.1)	76.2 (10.0)	73.7 (11.0)	0.99 (0.97–1.01)	0.1	0.98 (0.95–1.00)	0.06	0.99 (0.97–1.01)	0.3	0.98 (0.95–1.00)	0.2

Table 4 (continued)

	N (%)			Unadjusted analysis			Adjusted analysis[b]		
	Short sleep < 6:00 h/night	Referent sleep 6:00–7:59 h/night	Long sleep ≥ 8:00 h/night	Short vs. referent sleep duration		Long vs. referent sleep duration	Short vs. referent sleep duration		Long vs. referent sleep duration
Hypertension, *n* (%)	53 (27.0)	49 (21.3)	17 (22.7)	1.37 (0.88–2.14)	0.2	1.08 (0.58–2.03)	0.8	1.06 (0.65–1.74)	0.8	1.06 (0.53–2.11)	0.9
Dyslipidemia, *n* (%)	52 (26.5)	46 (20.0)	22 (29.3)	1.44 (0.92–2.27)	0.1	1.66 (0.92–3.00)	0.09	1.16 (0.71–1.89)	0.5	1.76 (0.91–3.38)	0.09
Arthritis, *n* (%)	44 (22.4)	36 (15.7)	7 (9.3)	1.56 (0.96–2.54)	0.08	0.56 (0.24–1.31)	0.2	1.23 (0.74–2.05)	0.4	0.48 (0.20–1.13)	0.09
Thyroid disease, *n* (%)	29 (14.8)	27 (11.7)	4 (5.3)	1.31 (0.74–2.29)	0.3	0.42 (0.14–1.25)	0.1	0.99 (0.55–1.79)	1.0	0.33 (0.11–1.00)	0.05
Diabetes, *n* (%)	28 (14.3)	22 (9.6)	14 (18.7)	1.58 (0.87–2.86)	0.1	2.17 (1.05–4.50)	**0.04**	1.30 (0.70–2.42)	0.4	2.30 (1.06–4.96)	**0.04**
Other diseases[a], *n* (%)	32 (16.3)	29 (12.6)	8 (10.7)	1.35 (0.79–2.32)	0.3	0.83 (0.36–1.90)	0.7	1.15 (0.66–2.01)	0.6	0.79 (0.34–1.81)	0.57

Bold entries correspond to significant *p*-value <0.05

[a] Other diseases include coronary artery disease ($n = 22$), chronic bronchitis or emphysema ($n = 26$), liver disease ($n = 14$), cancer ($n = 8$), or stroke ($n = 7$)

[b] Multinomial regression analysis adjusted for age and sex (sex differences are adjusted for age, age differences are adjusted for sex, and prevalence of post-menopause is not adjusted, all other comparisons are adjusted for both age and sex)

conditions such as hypertension and diabetes [2]; however, the association did not reach statistical significance in our sample likely due to the smaller sample size and younger age of our participants compared to other cohorts.

The association of older age and female sex with short sleep duration in our sample is consistent with several studies that have similarly concluded that on average, sleep duration is shorter among females and decreases with age [26]. Short sleep duration was also associated with a trend for higher arthritis prevalence in our sample, also consistent with studies that implicated chronic pain in sleep disturbance [27]. Likewise, the trends for increased caffeine consumption and greater BMI among short sleepers (< 6:00 h/night) in our sample are also consistent with prior studies reporting that short sleepers consumed more caffeine [28] and had greater BMI [2] than normal and long sleepers. However, contrary to prior studies that reported higher calorie consumption in short sleepers [29], in our sample, short sleepers (< 6:00 h/night) reported less calorie consumption than referent and long sleepers.

This study is limited by the cross-sectional design that does not allow determining the direction of association and causality. Although self-reported sleep duration could be biased by the desire to appear "normal" or to express dissatisfaction or recall biases, it tends to overestimate (rather than underestimate) sleep duration compared to actigraphy and sleep diaries [30] and has shown good correlation with actigraphy and sleep diaries [31, 32]. Nevertheless, self-reported sleep durations has not been specifically validated in Arabic speaking individuals. Generalizability is also limited as this study sample was recruited from an urban area of the country and may not represent other parts of the country, although 50% of the population of Lebanon lives in Greater Beirut, an area considered the melting pot of the country. Furthermore, although this study sample was selected randomly, selection bias cannot be excluded. National census data are not available from Lebanon and data on response and attrition rates are not available on our sample to assess selection bias. Stay-at-home and unemployed women would be more likely to participate in this study that required a visit to the university during working hours. However, the high prevalence of female participants in our sample could be also partly reflective of the high male to female emigration rates from Lebanon reported at > 2:1 and estimated to affect 45% of Lebanese families [33]. Likewise, the high prevalence of unemployment, low education level, and low income in this sample especially among females could also be reflective of the adverse socio-economic conditions in Lebanon [34] and in developing countries in general.

Table 5 Associations of subjective sleep insufficiency, daytime fatigue and weekdays sleep debt with sleep duration (N=501)

				Usual sleep duration											
	N (%)			Unadjusted analysis						Adjusted analysis[c]					
	Short <6:00 hours /night	Referent 6:00-7:59 hours /night	Long ≥8:00 hours /night	Short vs. Referent sleep duration		Referent vs. long sleep duration		Short vs. Long sleep duration		Short vs. Referent sleep duration		Referent vs. long sleep duration		Short vs. Long sleep duration	
Daytime symptoms	N=196	N=230	N=75	OR (95%CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p
Subjective sleep insufficiency[a], *n (%)*	101 (52.9)	61 (27.2)	15 (20.0)	3.00 (2.00-4.48)	**<0.01**	1.51 (0.80-2.85)	0.21	4.52 (2.41-8.51)	**<0.01**	3.01 (1.2-4.54)	**<0.01**	1.51 (0.80-2.85)	0.2	4.54 (2.40-8.55)	**<0.01**
Post awakening fatigue[b], *n (%)*	103 (53.1)	92 (40.2)	37 (49.3)	1.66 (1.13-2.44)	**0.01**	0.68 (0.41-1.16)	0.16	1.14 (0.67-1.94)	0.64	1.58 (1.06-2.30)	**0.02**	0.70 (0.42-1.19)	0.2	1.11 (0.65-1.89)	0.7
Daytime fatigue[b], *n (%)*	105 (53.8)	99 (43.0)	29 (38.7)	1.53 (1.04-2.24)	**0.03**	1.20 (0.70-2.04)	0.51	1.83 (1.06-2.04)	**0.03**	1.42 (0.96-2.10)	0.08	1.33 (0.73-2.14)	0.4	1.78 (1.03-3.07)	**0.03**
				Weekdays sleep duration											
	Short <6:00 hours /night	Referent 6:00-7:59 hours /night	Long ≥8:00 hours /night	Short vs. referent sleep duration		Referent vs. long sleep duration		Short vs. long sleep duration		Short vs. Referent sleep duration		Referent vs. long sleep duration		Short vs. Long sleep duration	
Weekends vs. Weekdays sleep duration	N=199	N=224	N=78	OR* (95%CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p
Sleep longer on weekends, n (%)	53 (26.6)	85 (37.9)	10 (12.8)	0.59 (0.39-0.90)	**0.01**	4.16 (2.03-8.51)	**<0.01**	2.47 (1.18-5.15)	**0.02**	0.67 (0.44-1.03)	0.06	4.14 (2.00-8.57)	**<0.01**	2.77 (1.31-5.86)	**0.008**
Same sleep duration on weekends, n (%)	143 (71.9)	128 (57.1)	63 (80.8)	1.91 (1.27-2.88)	**<0.01**	0.32 (0.17-0.59)	**<0.01**	0.61 (0.32-1.16)	0.13	1.91 (1.27-2.88)	**<0.01**	0.32 (0.17-0.59)	**<0.01**	0.61 (0.32-1.16)	0.13
Sleep less on weekends, n (%)	3 (1.5)	11 (4.9)	5 (6.4)	0.30 (0.08-1.08)	0.07	0.75 (0.25-2.24)	0.61	0.22 (0.05-0.96)	0.04	0.32 (0.09-1.16)	0.08	0.74 (0.24-2.17)	0.57	0.23 (0.05-0.99)	**0.04**

[a] Almost always (16 to 30 times per month)

[b] Nearly every day or 3-4 times a week

[c] Multinomial regression analysis adjusted for age, sex and their interaction age*sex

Furthermore, the prevalence of short sleeper was similar in employed and unemployed participants, and long sleepers were more likely to be unemployed compared to normal and short sleepers. Thus, the high prevalence of short sleep in our sample is unlikely to be attributed to oversampling of unemployed individuals. Finally, although individuals with self-reported mental health disorders were excluded from our study, lack of screening for undiagnosed anxiety and depression in our sample limits the interpretation of our findings. Balancing these limitations are several strengths including the evaluation of a community-based sample, the adoption of systematic sampling methods with face-to-face interview, and the novelty of evaluating sleep duration in a sample from a developing country with a high prevalence of unemployment, low education level, and low income.

Conclusion

In conclusion, short sleep duration is highly prevalent in this urban cohort from a medium- to low-income country compared to other developed countries especially among women and older adults and is associated with subjective sleep insufficiency, daytime fatigue, and weekday sleep debt. This finding is alarming as short sleep can negatively impact the health and well-being of the population. Further multinational comparative research that assesses local-regional and socio-cultural determinants of sleep duration and behaviors and the local attitudes towards sleep is needed to better evaluate the causes and implications of short sleep duration in different populations.

Acknowledgments We acknowledge the contribution of the following volunteer students under the Medical Research Volunteer Program (MRVP) at the American University of Beirut: Michael Dagher, Abdulhamid Sabih, Lama Assi, Muhieddine Laban, Hisham Wehbe, Alaa Osta, Carine Baassiri, and Ali Jaber. Moreover, we would like to thank Juliana Breidy, Patricia Moghames, Joanna Bou Rizk, Christelle Cordahi, Zeinab Awada, Aya Noubani, Lara Itani, and Mohamad Medawar for their contribution in data collection.

Funding This work was funded by the medical practice plan grants at the American University of Beirut and the Lebanese National Council for Scientific Research.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Jackson CL, Redline S, Emmons KM (2015) Sleep as a potential fundamental contributor to disparities in cardiovascular health. Annu Rev Public Health 36:417–440 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4736723/
2. Knutson KL (2010) Sleep duration and cardiometabolic risk: a review of the epidemiologic evidence. Best Pract Res Clin Endocrinol Metab 24:731–743 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3011978/
3. Grandner MA, Patel NP, Gehrman PR, Perlis ML, Pack AI (2010) Problems associated with short sleep: bridging the gap between laboratory and epidemiological studies. Sleep Med Rev 14:239–247
4. Leproult R, Deliens G, Gilson M, Peigneux P (2015) Beneficial impact of sleep extension on fasting insulin sensitivity in adults with habitual sleep restriction. Sleep 38:707–715 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4402666/
5. Haack M, Serrador J, Cohen D, Simpson N, Meier-Ewert H, Mullington JM (2013) Increasing sleep duration to lower beat-to-beat blood pressure: a pilot study. J Sleep Res 22:295–304 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3582793/
6. Holliday EG, Magee CA, Kritharides L, Banks E, Attia J (2013) Short sleep duration is associated with risk of future diabetes but not cardiovascular disease: a prospective study and meta-analysis. PLoS One 8:e82305 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3840027/
7. Hale L, Do DP (2007) Racial differences in self-reports of sleep duration in a population-based study. Sleep 30:1096–1103 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1978399/
8. Grandner MA, Williams NJ, Knutson KL, Roberts D, Jean-Louis G (2016) Sleep disparity, race/ethnicity, and socioeconomic position. Sleep Med 18:7–18 https://www.ncbi.nlm.nih.gov/pubmed/26431755
9. Groeger JA, Zijlstra F, Dijk DJ (2004) Sleep quantity, sleep difficulties and their perceived consequences in a representative sample of some 2000 British adults. J Sleep Res 13:359–371 https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2869.2004.00418.x
10. Ursin R, Bjorvatn B, Holsten F (2005) Sleep duration, subjective sleep need, and sleep habits of 40-to 45-year-olds in the Hordaland Health Study. Sleep 28:1260–1269 https://pdfs.semanticscholar.org/1c2e/5f66b8efab48a71e9c5178fdb06d17025f37.pdf
11. Assaad S, Costanian C, Haddad G, Tannous F (2014) Sleep patterns and disorders among university students in Lebanon. J Res Health Sci 14:198–204 http://jrhs.umsha.ac.ir/index.php/JRHS/article/view/1485/html
12. Kabrita CS, Hajjar-Muça TA, Duffy JF (2014) Predictors of poor sleep quality among Lebanese university students: association between evening typology, lifestyle behaviors, and sleep habits. Nat Sci Sleep 6:11 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3894960/
13. Nasreddine L, Tamim H, Itani L, Nasrallah MP, Isma'eel H, Nakhoul NF, Abou-Rizk J, Naja F (2107) A minimally processed dietary pattern is associated with lower odds of metabolic syndrome among Lebanese adults. Public Health Nutr 21:160–171. https://doi.org/10.1017/S1368980017002130
14. Quan SF, Howard BV, Iber C, Kiley JP, Nieto FJ, O'Connor GT, Rapoport DM, Redline S, Robbins J, Samet JM, Wahl PW (1997) The sleep heart health study: design, rationale, and methods. Sleep 20:1077–1085 https://www.ncbi.nlm.nih.gov/pubmed/9493915

15. Saleh AB, Ahmad MA, Awadalla NJ (2011) Development of Arabic version of Berlin questionnaire to identify obstructive sleep apnea at risk patients. Ann Thorac Med 6:212–216 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3183638/
16. Gottlieb DJ, Punjabi NM, Newman AB, Resnick HE, Redline S, Baldwin CM, Nieto FJ (2005) Association of sleep time with diabetes mellitus and impaired glucose tolerance. Arch Intern Med 165:863–867 https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/486518
17. Arora T, Chen MZ, Cooper AR, Andrews RC, Taheri S (2016) The impact of sleep debt on excess adiposity and insulin sensitivity in patients with early type 2 diabetes mellitus. J Clin Sleep Med 12:673–680 https://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC4865553&blobtype=pdf
18. Nasreddine L, Hwalla N, Sibai A, Hamzé M, Parent-Massin D (2002) Food consumption patterns in an adult urban population in Beirut, Lebanon. Toxicol Lett 127:29–41 https://www.cambridge.org/core/services/aop-cambridge-core/content/view/1515E29F50FD6C9D07AA4A8E96B54702/S1368980006000383a.pdf/food_consumption_patterns_in_an_adult_urban_population_in_beirut_lebanon.pdf
19. International Physical Activity Questionnaire (IPAQ). (2005) Guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ) - short form. https://Users/ln10/Downloads/GuidelinesforDataProcessingandAnalysisoftheInternationalPhysicalActivityQuestionnaireIPAQShortandLongForms%20(1).pdf. Accessed 1 Dec 2018
20. Ikehara S, Iso H, Date C, Kikuchi S, Watanabe Y, Wada Y, Inaba Y, Tamakoshi A, JACC Study Group (2009) Association of sleep duration with mortality from cardiovascular disease and other causes for Japanese men and women: the JACC study. Sleep 32:295–230 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2647783/
21. Cai H, Shu X-O, Xiang Y-B, Yang G, Li H, Ji BT, Gao J, Gao YT, Zheng W (2015) Sleep duration and mortality: a prospective study of 113,138 middle-aged and elderly Chinese men and women. Sleep 38:529–536 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4355892/
22. Kim J-H, Kim KR, Cho KH et al (2013) The association between sleep duration and self-rated health in the Korean general population. J Clin Sleep Med 9:1057 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3778177/
23. Ahmed AE, Al-Jahdali F, AlALwan A et al (2017) Prevalence of sleep duration among Saudi adults. Saudi Med J 38:276. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5387904/–283
24. El Masri A, Kolt GS, Astell-Burt T et al (2017) Lifestyle behaviours of Lebanese-Australians: cross-sectional findings from the 45 and up study. PLoS One 12:e0181217 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5509310/
25. Karam EG, Mneimneh ZN, Dimassi H, Fayyad JA, Karam AN, Nasser SC, Chatterji S, Kessler RC (2008) Lifetime prevalence of mental disorders in Lebanon: first onset, treatment, and exposure to war. PLoS Med 5:e61 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2276523/
26. Chandola T, Ferrie JE, Perski A, Akbaraly T, Marmot MG (2010) The effect of short sleep duration on coronary heart disease risk is greatest among those with sleep disturbance: a prospective study from the Whitehall II cohort. Sleep 33:739–744 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2880242/
27. Nunes J, Jean-Louis G, Zizi F, Casimir GJ, von Gizycki H, Brown CD, McFarlane SI (2008) Sleep duration among black and white Americans: results of the National Health Interview Survey. J Natl Med Assoc 100:317–322 https://linkinghub.elsevier.com/retrieve/pii/S0027-9684(15)31244-X
28. Patel SR, Malhotra A, Gottlieb DJ, White DP, Hu FB (2006) Correlates of long sleep duration. Sleep 29:881–889 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3500381/
29. Grandner MA, Kripke DF, Naidoo N, Langer RD (2010) Relationships among dietary nutrients and subjective sleep, objective sleep, and napping in women. Sleep Med 11:180–184
30. Matthews KA, Patel SR, Pantesco EJ, Buysse DJ, Kamarck TW, Lee L, Hall MH (2018) Similarities and differences in estimates of sleep duration by polysomnography, actigraphy, diary, and self-reported habitual sleep in a community sample. Sleep Health 4:96–103 https://linkinghub.elsevier.com/retrieve/pii/S2352-7218(17)30224-3
31. Lockley SW, Skene DJ, Arendt J (1999) Comparison between subjective and actigraphic measurement of sleep and sleep rhythms. J Sleep Res 8:175–183 https://onlinelibrary.wiley.com/doi/epdf/10.1046/j.1365-2869.1999.00155.x
32. Patel SR, Ayas NT, Malhotra MR, White DP, Schernhammer ES, Speizer FE, Stampfer MJ, Hu FB (2004) A prospective study of sleep duration and mortality risk in women. Sleep 27:440–444 http://livebetterlife.net/wp-content/uploads/2013/09/270310.pdf
33. Tabar P. Immigration and Human Development: Evidence from Lebanon. United Nations Development Programme, Human Development Reports. Research Paper 2009/35. August 2009. https://mpra.ub.uni-muenchen.de/19219/1/MPRA_paper_19219.pdf. Accessed 1 Dec 2018
34. Le Borgne E, Jacobs TJ. (2016) *Lebanon: Promoting Poverty Reduction and Shared Prosperity.* World Bank Group. http://documents.worldbank.org/curated/en/951911467995104328/pdf/103201-REPLACEMNT-PUBLIC-Lebanon-SCD-Le-Borgne-and-Jacobs-2016.pdf. Accessed 1 Dec 2018