Research Article • DOI: 10.1515/tnsci-2016-0010 • Translational Neuroscience • 7 • 2016 • 62-70

DE GRUYTER OPEN

SLEEP-WAKE PATTERNS AND SLEEP QUALITY IN URBAN GEORGIA

Irine Sakhelashvili[1], Marine Eliozishvili[1], Tamar Basishvili[1], Maia Datunashvili[1], Nikoloz Oniani[1], Katerina Cervena[2#], Nato Darchia[1#*]

[1]Research center - T. Oniani Laboratory of Sleep-Wakefulness Cycle Studies, Ilia State University, Tbilisi, Georgia

[2]Sleep Medicine Center, Division of Pneumology, University Hospital of Geneva, Geneva, Switzerland

#equally contributing co-authors

Received 14 April 2106
accepted 23 June 2016

Abstract

Objectives: Sleep problems represent a worldwide health concern but their prevalence and impacts are unknown in most non-European/North American countries. This study aimed to evaluate sleep-wake patterns, sleep quality and potential correlates of poor sleep in a sample of the urban Georgian population. Methods: Analyses are based on 395 volunteers (267 females, 128 males, aged 20-60 years) of the Georgia Somnus Study. Subjects completed the Pittsburgh Sleep Quality Index (PSQI) and the Beck Depression Inventory-Short Form. Sociodemographic information and self-reported height and weight were collected. Results: 43% of subjects had poor sleep quality (PSQI > 5). Further, 41% had low sleep efficiency, 27.6% slept 6 hours or less, 32.4% went to bed after midnight, 27.6% snored, 10.6% were taking sleep medication, and 26.8% had sleep maintenance problems as occurring three or more times a week. The latest bedtime, rise time, and gender effect on these variables were found in the age group 20-29 years. PSQI global score showed a significant age but not gender difference. The economic status and the depression score were two significant predictors of sleep quality. Conclusions: Poor sleep quality has a high prevalence and is strongly linked to the economic status. Study findings call for a global assessment of sleep problems in countries where sleep disturbances represent an insufficiently recognized public health issue.

Keywords

Economic status • Georgia • Public health • Sleep behavior • Sleep quality • Urban population.

Introduction

Sleep disturbances are highly prevalent in modern societies and represent a growing health concern worldwide. The current knowledge on this issue clearly indicates that sleep-related complaints are linked to a variety of health problems with implications in almost every field of medicine [1-3]. Sleep disorders are associated with increased risk for cardiovascular and metabolic diseases, mood disorders, vehicle or work-related accidents, and with a decline in cognitive performance and health-related quality of life [2, 4-8]. Thus, on a broader scale, insufficient sleep may seriously compromise individuals' health status, well-being and safety.

In the last decades, the major discoveries in the neurobiology, neurochemistry and the genetic basis of sleep disorders, has significantly advanced our understanding of the etiology of sleep disturbances, the assessment of the risks of their development, and the potential mechanisms for their prevention and treatment. However, to benefit from these achievements, it is necessary to recognize the significance of sleep for health at the national level. Therefore, the assessment of sleep quality and the prevalence of sleep disorders in different countries are of crucial importance for several reasons: first, to advance the sleep field at the national levels; second, to understand the impact of sleep disorders on health, quality of life, and safety in the different cultural contexts; and third, to recognize sleep as an important health-related issue and to draw the attention of local public health authorities to the scope of the problem [2].

The epidemiological studies provide the scientific framework for addressing these issues step-by-step, however, current evidence indicates that the epidemiology of sleep disorders is well studied mostly in Western countries [9-13]. On the other hand, the prevalence of sleep problems and their impacts are unknown in most non-European/North American countries. This imbalance may reflect a low level of sleep medicine development in those countries, and even a low awareness of public authorities and health care practitioners about the significance of sleep for health. Consequently, the greater percentage of individuals with sleep disorders are not diagnosed and treated. At the same time accelerating trends towards urbanization in developing world often brings risks of social instability and health problems. The general circumstances are similar in Georgia - the field of practical sleep medicine and general awareness about sleep health issues are at low level. Moreover, only very few studies have examined sleep problems in Georgia, but those studies were mainly targeted to defined sub-populations such as internally displaced population or patients of primary healthcare centers [14-16]. Hence the data on the prevalence of sleep disturbances in the country are lacking. To fill this gap, the present study aims to provide subjective data on sleep-

* *E-mail: nato.darchia@iliauni.edu.ge*

wake patterns and the prevalence of poor sleep quality, and to examine factors associated with poor sleep in a sample of the Georgian urban population.

Methods

The study

The study was approved by the Ethics Committee of Ilia State University, Tbilisi, Georgia. Informed consent was obtained from all participants included in the study. The cross-sectional Georgia Somnus Study was carried out between April and May, 2013 and included 395 unpaid volunteers, aged between 20 and 60 years old. Information on study participants were collected through the following questionnaires - Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index, Stop-Bang questionnaire, Epworth Sleepiness Scale, Back Depression Inventory-short form (BDI-SF) and Health Related Quality of Life (SF-12). Socio-demographic information and anthropometric data (height, weight) were collected. PSQI, BDI-SF, socio-demographic and anthropometric data from the Georgia Somnus Study were used for the present analyses.

Subjects and procedure

The sample of the study consisted of residents of Tbilisi (the capital) and Kutaisi (the second largest city of Georgia). These cities were selected based on their population size and urbanization rates. In 2013, the population of Georgia was about 4.5 million with an urbanization rate above 50% [17]. Tbilisi accounts for more than 30% of Georgia's total population and is the only city with advanced urbanization stage. Moreover, 97% of the population in Tbilisi lives in urban areas. Tbilisi is followed by the city of Kutaisi (the main city of the next most urbanized region after Tbilisi) which has about 200,000 residents and falls into intermediate urbanization stage category [18]. As the number of subjects, given the total urban population of the country (about 1.3 million, age range 20-60 years), the sample size is proportionally comparable to other population-based studies [9, 13, 19, 20].

Subjects were recruited through advertisements in schools, universities, public squares and churches, as well as through word of mouth recommendations. All subjects were provided with detailed information on the purpose, methods, and time requirements of the study. Subjects who were unable to complete the interview and fill out the questionnaires due to language difficulties or medical reasons (e.g., cognitive impairment or severe health conditions) were excluded from the study. Experienced research assistants carried out individual interviews at locations chosen by the participants. In addition to these face-to-face interviews, the participants completed validated self-report questionnaires. Difficulties with recruitment procedure were related to a subject of investigation, since sleep problems were not perceived seriously. To increase the participation rate research assistants were present in public squares on weekends, at different parts of the city, and carried out the interviews in subjects willing to volunteer for the study.

The Somnus study considered to increase the general awareness about the importance of sleep for health but did not consider referring subjects to any medical help. Therefore, all subjects, including those who did not agree on interviews, got information about the role of sleep for health, quality of life and safety and were suggested to discuss with health care professionals their sleep problems, if any. Thus, the possibility that subjects with concerns about their sleep may have been more likely to participate in order to get the professional help, is ruled out.

Measures

Interview. The interview covered the major sociodemographic information of participants such as age (categorized into four groups with a range of 10 years), gender, marital status (categorized into 2 groups - married/cohabiting and single/divorced/widowed), educational level (high school, college, or university), current employment status (employed or unemployed), and economic status based on household income (rated from 1 [very bad] to 6 [very good]). In addition, the subjects reported their height and weight to calculate their body mass index (BMI).

Pittsburgh Sleep Quality Index (PSQI). Sleep quality was assessed by using the PSQI, one of the most widely used self-reported questionnaires for clinical and research purposes [21]. The PSQI examines sleep over a 1-month time interval and consists of 19 self-rated items grouped into 7 component scores: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. These components, weighted equally on a 0-3 scale, are summed to come up with a Global Sleep Quality PSQI score ranging from 0 (high quality of sleep) to 21 (low quality of sleep). A global PSQI score of >5 is generally considered to indicate poor sleep quality.

The PSQI was translated into Georgian by a bi-lingual translator using a standard translation protocol, followed by a back-translation to ensure the equivalence. The translated questionnaire was reviewed and pretesting was done to check for accuracy, consistency with the original version, and to refine the instrument further. In this study, the Cronbach's-α of the PSQI 7 components score was 0.77.

The Beck Depression Inventory-Short Form (BDI-SF). The BDI-SF is a 13-item subset of the original instrument used to assess depressive symptoms based on a 4-point scale [22]. High scores suggest a high depressive symptomatology. The test-retest reliability of the original BDI questionnaire in Georgian translation has been assessed in previous investigations [14].

Statistical analysis

Descriptive analyses were used to present demographic (age, gender, marital status, educational level, employment and economic status) and health (BDI-SF and BMI) characteristics. These characteristics were summarized by using counts and percentages for categorical variables, and means and standard deviations for continuous variables. For comparisons, variables were checked for assumptions on the use of parametric and non-parametric tests and then analyzed accordingly. Because the normality of assumptions was not satisfied, all PSQI components and global scores were analyzed with the Mann-Whitney test. A Kruskal-Wallis *H* test was used to find differences in the PSQI measures according to age group or gender. The sleep-wake behavior (bedtime, sleep latency, rise time, total sleep time) across age groups was investigated by two-way ANOVA with age group and gender as main factors. For significant ANOVAs, multiple comparisons were carried out with the use of Tukey *post-hoc* analysis. When necessary, to decompose interaction effects, simple effects analysis was done by using the syntax procedure in the SPSS software. Bedtime, rise time, and actual sleep time were expressed in decimal hours, and sleep latency in minutes.

Good and poor sleepers (PSQI cut off score >5) were compared on demographic and health variables with Mann-Whitney test for continuous variables and with chi-square tests for categorical variables. For non-parametric tests, the median and inter-quartile ranges are reported.

Spearman correlation analysis was used to assess the relationship between sleep quality and demographic and health variables. To identify factors associated with poor sleep, variables that showed a significant bivariate correlation with sleep quality were entered in multiple logistic regression analysis. The odds ratios and 95% confidence interval (CI) are reported.

The significance level was set at $\alpha = 0.05$. All statistical analyses were conducted using PASW Statistics v. 21.0 (SPSS Inc., Chicago, IL, USA).

Results

General characteristics

Table 1 presents the demographic and health characteristics of the population. The participants had a mean age of 37.65 years (SD = 10.78, range: 20-60 years), and most of them (28.9%) belonged to the youngest age group. There were about twice more females than males (67.6% *versus* 32.4%). The majority of subjects had a University degree (80.8%), were married or cohabiting (68.4%) and were employed (68.9%). The economic status of participants showed large variations ranging from very bad (3.3%) to very good (9.1%), with the highest proportion falling in the average level (45.6%).

Sleep-wake patterns (derived from the PSQI)

Figure 1 presents the sleep-wake patterns of the studied population. The average bedtime was 24.03 ± 1.05 h. The data showed that about 31.1% of subjects went to bed between 23:00 and 24:00 h; 29.6% at midnight, and 32.4% after midnight. The 2-way ANOVA indicated a significant main effect of age on bedtime ($F_{3,387}$ = 14.532, $p < 0.001$). There was no statistically significant main effect of gender on bedtime ($F_{1,387}$ = 2.950, p = 0.087), but the interaction between the factors was significant ($F_{3,387}$ = 7.438, $p < 0.001$). Therefore, we analyzed gender effects within each age group and the effect of age separately for men and women. Simple main effects analysis showed that males had later bedtimes compared with females in the age group 20-29 years ($F_{1,387}$ = 24.678, $p < 0.001$), but there were no differences between genders in any other age group. Analyzing the effect of age showed that bedtime did not differ between age groups within females, also difference inter youngest and oldest groups approached significance (p = 0.061). Among males, all age groups were significantly different from the age group 20-29 years (all differences at $p < 0.001$).

The average sleep latency was 18.56 ± 13.27 min. The 2-way ANOVA showed a significant main effect of gender ($F_{1,387}$ = 10.737, $p < 0.01$), but the main effect of age was not statistically significant ($F_{3,387}$ = 0.958, p = 0.412); the interaction between age group and gender was also significant ($F_{3,387}$ = 2.789, $p < 0.05$). Simple main effects analysis showed a gender effect in the age group 50-60 years, with females needing more time to fall asleep compared with males ($F_{1,387}$ = 12.430, $p < 0.001$). There were no gender differences in sleep latency in any other age group. The effect of age was significant only in females, such that sleep latency in subjects aged 50-60 years differed from all other age groups (all differences at $p < 0.05$).

The average rise time was 7.99 ± 1.03 h. Generally, the rise time in the majority of

Table 1. Demographic and health characteristics of the study population.

	n	%
Age groups		
20-30	114	28.9
31-40	104	26.3
41-50	112	28.3
51-60	65	16.5
Gender		
Female	267	67.6
Male	128	32.4
Marital status		
married/cohabiting single/di-vorced/widowed	270 125	68.4 31.6
Education		
High school	32	8.1
College	44	11.1
University	319	80.8
Employment status		
employed	272	68.9
unemployed	123	31.1
Economic level		
Very bad	13	3.3
Bad	60	15.2
Average	180	45.6
Good	106	26.8
Very good	36	9.1
	Mean	SD
Age	37.6	10.78
BMI	25.31	5.15
BDI-SF	4.16	4.34

Data are presented as frequencies and percentages or as means and standard deviations. BDI-SF, Beck Depression Inventory-Short Form; BMI, Body Mass Index.

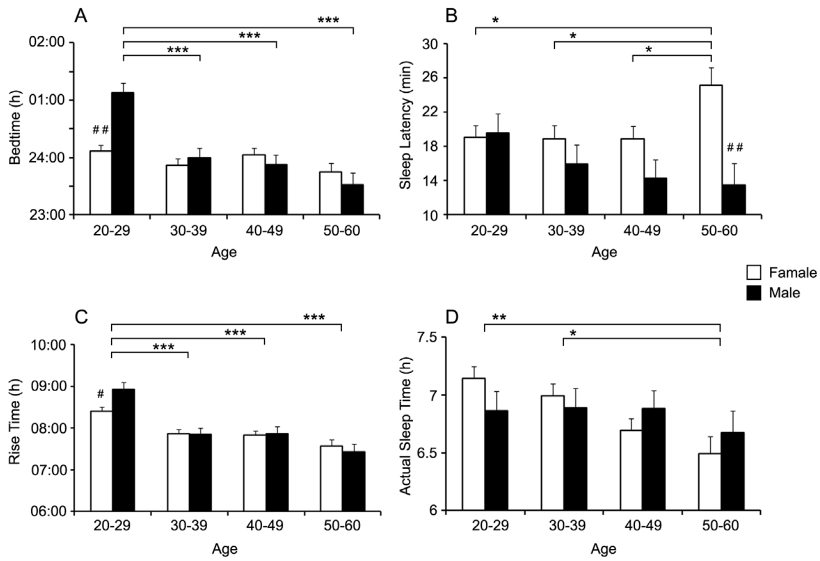

Figure 1. Sleep-wake parameters according to age groups and gender. A. Bedtime (hours); black lines correspond to the significant effect of age in males. B. Sleep latency (minutes); black lines correspond to the significant effect of age in females. C. Time of getting up (hours); black lines connect significantly different age groups. D. Actual sleep time (hours); black lines connect significantly different age groups. Data are analyzed by two-way ANOVA with factors "age group" and "gender". Values are mean ± SEM. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. # - number signs mark significant gender differences. $^{\#}p < 0.5$, $^{\#\#}p < 0.001$.

subjects (about 66.8% of the total sample) was between 7:00 and 8:00 h. The 2-way ANOVA showed a significant main effect of age on this variable ($F_{3,387} = 22.045$, $p < 0.001$). However, there was no statistically significant main effect of gender ($F_{1,387} = 0.953$, $p = 0.330$), nor was the interaction between the factors significant ($F_{3,387} = 2.023$, $p = 0.110$). The Tukey *post-hoc* analysis showed no difference in rise time between the age groups 30-39, 40-49, and 50-60 years; however, the rise times of all these age groups were significantly different from that of subjects 20-29 years old (all differences at $p < 0.001$), suggesting a nonlinear relationship between age and rise time. Therefore, we took a closer look at this age group to find out if there was a gender difference and found that males had later rise time compared with females (one-way ANOVA; $F_{1,112} = 4.836$, $p < 0.05$).

The average total sleep time was 6.86 ± 0.96 h. The distribution of actual sleep time showed several peaks: 6 h of sleep was observed in 15.2% of the studied population, 6.5 h in 11.1%, 7 h in 18.2%, 7.5 h in 14.4%, and 8 h in 11.6%. The 2-way ANOVA indicated that age had a significant main effect on total sleep time ($F_{3,387} = 2.843$, $p < 0.05$). There was no statistically significant main effect of gender on sleep time ($F_{1,387} = 0.953$, $p = 0.330$), nor the interaction between the factors was significant ($F_{3,387} = 2.023$, $p = 0.110$). The Tukey post-hoc analysis showed a significant difference in total sleep time between the age group 50-60 years, which had the shortest sleep duration (6.56 ± 0.1 h), and the age groups 20-29 years (7.05 ± 0.09 h, $p < 0.01$) and 30-39 years (6.96 ± 0.1 h, $p < 0.05$).

PSQI Components

None of the seven component scores of the PSQI showed a significant gender difference.

PSQI1: Subjective sleep quality. "Very good" sleep quality was reported by 21.5% of the population. The lowest percentage of "very good" sleep quality was stated by participants 50-60 years old (9.2% relative to this age category). "Fairly good" was the most frequently reported sleep quality – by 49.1% of participants. "Fairly bad" and "very bad" sleep quality were reported by 27.6% and 1.8% of the total study population, respectively. The difference in PSQI1 component scores was not significant for age ($p = 0.130$).

PSQI2: Sleep latency longer than 30 min. Sleep latency was assessed on a scale of 0-3 based on the minutes required to fall asleep and the frequency of difficulties of falling asleep within 30 min per week. The percentage of the population with sleep latency score of 2 and 3 was 10.4% and 9.6%, respectively. The difference in the PSQI2 component scores was not significant for or age ($p = 0.315$).

PSQI3: Sleep duration. The actual sleeping time in 38.2% of the population was more than 7 h; 34.4% scored 1 (6-7 h) and 26.1% scored 2 (5-6 h) on PSQI3, whereas 1.3% reported an actual sleep time of less than 5 h. A Kruskal-Wallis *H* test showed a significant difference in the PSQI3 component scores between age groups ($\chi^2(3) = 15.589$; $p < 0.01$).

PSQI4: Sleep efficiency. The sleep efficiency in 59% of the studied population was equal to or more than 85%; 32.6% reported 75-84% sleep efficiency, whereas 6.6% and 1.8% reported sleep efficiencies of 65-74% and less than 65%, respectively. The difference in the PSQI4 component scores did not reach significance for age ($p = 0.156$).

PSQI5: Sleep disturbances. Among the studied population, 7.1% had no sleep disturbances; 77.2 % had a sleep disturbance score of 1, 15.7% scored 2, and none of the subjects scored 3 on PSQI5. There was a significant difference in the PSQI5 scores between age groups ($\chi^2(3) = 12.871$; $p < 0.01$). When the subscales of this component score were analyzed separately, difficulties with sleep maintenance was found to be the most frequent reason for sleep disturbances, reported by 26.8% of the population as occurring three or more times a week. Snoring (score 1 to 3) was reported by 27.6% of subjects. There was a significant difference in snoring frequency between age groups ($\chi^2(3) = 22.999$; $p < 0.01$). Among those, aged between 20-29 years, 84.2% never snored. This value decreased to 76.9% for ages 30-39 years, to 67.8% for 40-49 years, and to 52.3% for 50-60 years.

PSQI6: Use of sleep medication. Among the studied population, 10.6% reported taking sleep medication, with the following frequencies of consumption: less than once a week for 7.1%, once or twice a week for 2.8%, and three or more times a week for only 0.8%.

The age difference in the use of hypnotics was not significant ($\chi^2(3)$ = 1.699; p = 0.637), although the highest proportion of sleep medication intake was observed in the age group 50-60 years (13.8%).

PSQI7: Daytime dysfunction. Among the subjects, 30.9% did not have any trouble with daytime functioning; 59.7% reported difficulties in staying awake and problems in keeping up enthusiasm to get things done less than once a week. Similar difficulties were experienced by 8.6% of subjects once or twice a week, and by only 0.8% three or more times a week. We found a significant difference in the PSQI7 scores between age groups ($\chi^2(3)$ = 10.746; $p < 0.05$). Among subjects 20-29 years old, 38.6% never had problems with daytime functioning. This percentage decreased to 35.6% for ages 30-39 years, to 27.7% for 40-49 years, and to 15.4% for 50-60 years.

Mean PSQI component scores according to age groups are presented in Table 2.

PSQI Global Score

The mean PSQI global score in the studied population was 5.46 ± 3.17. In poor sleepers it was 8.49 ± 2.15, and in good sleepers - 3.16 ± 1.38. Of the total population, 43% had poor sleep quality. Specifically, 42.3% of female and 44.5% of male subjects reported having poor sleep (PSQI > 5). However, the gender difference in the sleep quality mean scores did not reach the significance level (p = 0.896). Moreover, no significant gender effect was found in any age category, although in all age groups except 20-29 years, the mean PSQI score was higher in females than in males. In addition, poor sleepers were proportionally more frequent in females than in males across the age groups 30-39 years (42.3% *versus* 33.3%) and 50-60 years (56.4% *versus* 50%). A Kruskal-Wallis *H* test showed a significant difference in the PSQI global scores between age groups ($\chi^2(3)$ = 11.649; $p < 0.01$). Post-hoc Kruskal-Wallis test showed that the age groups 20-29 and 30-39 years had better sleep quality compared with the age group 50-60 years ($p < 0.05$). Figure 2 presents the differences in the mean PSQI global score according to age groups and gender.

Sociodemographic and health predictors of sleep quality

To determine the general characteristics of the population according to sleep quality, groups of good and poor sleepers were compared on demographic and health variables (Table 3). Statistical analyses revealed that the groups were significantly different on employment status, economic level, and depression score. The results of correlation analysis between these variables and sleep quality revealed that depression score (rs = 0.399, $p < 0.001$) and economic level (rs = -0.38, $p < 0.001$) had the most significant bivariate correlation, suggesting that a higher level of depression and lower economic status were associated with more disturbed sleep. Employment status had a weaker correlation with sleep quality (rs = 0.11, $p < 0.05$). Finally, logistic regression analysis for predicting poor versus good sleep quality was performed with employment status, economic level, depression score, and age as predictors. Age was included in the analysis to control for the severity of poor sleep because age was correlated with the PSQI global score (r = 0.15, $p < 0.01$). The overall model was statistically significant ($\chi^2(7)$ = 125.829, $p < 0.001$), explained 36.6% (*Nagelkerke* R^2) of the variance in sleep quality, and correctly classified 74.7% of cases. As shown in Table 4, economic status and depression score were both significant predictors of sleep quality. Compared with subjects with very good economic levels, those with very bad economic status had 11.22 times higher odds of having poor sleep quality; the odds were 11.87 times higher for those with

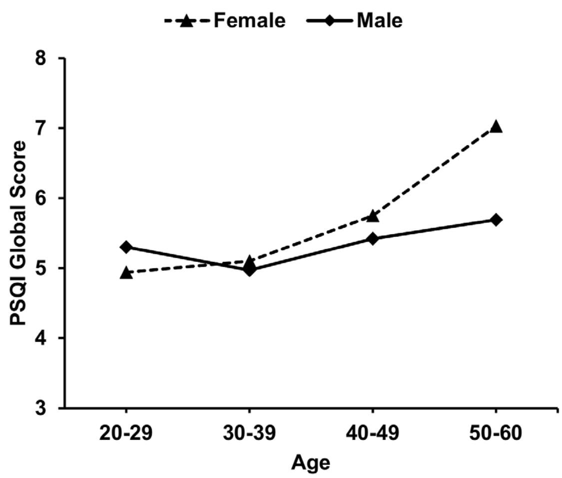

Figure 2. The trajectories of the mean PSQI global score by age categories and gender.

Table 2. PSQI component scores (mean and standard deviation) by age groups.

Age	PSQI 1	PSQI 2	PSQI 3	PSQI 4	PSQI 5	PSQI 6	PSQI 7
20-29	1.04 ± 0.74	0.99 ± 0.91	0.74 ± 0.82[a]	0.45 ± 0.74	0.96 ± 0.48[c]	0.16 ± 0.49	0.71 ± 0.65[d]
30-39	1.03 ± 0.74	0.83 ± 0.86	0.81 ± 0.84[b]	0.47 ± 0.64	1.1 ± 0.46	0.1 ± 0.36	0.72 ± 0.6[e]
40-49	1.12 ± 0.79	0.86 ± 0.96	1.0 ± 0.78[a,b]	0.53 ± 0.64	1.12 ± 0.44	0.19 ± 0.59	0.84 ± 0.64
50-60	1.28 ± 0.65	1.03 ± 1.02	1.18 ± 0.83	0.66 ± 0.8	1.22 ± 0.48[c]	0.15 ± 0.4	0.97 ± 0.53[d,e]

Means sharing the same superscript are significantly different from each other. a, c - p < 0.01; b, d, e - p < 0.05

bad economic status, and 2.7 times higher for those with average economic levels. Subjects with higher depression scores were 1.27 times more likely to have poor sleep. Employment status and age were not found to be significant predictors in this analysis.

Discussion

Different types of sleep problems are well recognized to have significant adverse impacts on quality of life and physical and/or mental health [1-3, 23]. Given the strong association between sleep and health, the prevalence of various sleep disturbances in different population warrants attention. To the best of our knowledge the present study is the first endeavor to provide comprehensive data on sleep habits and the prevalence of sleep problems in the Georgian population. The results described indicate that sleep problems are highly prevalent, at least in the urban population of Georgia. The prevalence rate of poor sleep quality, estimated by the PSQI global score, was 43% which is higher than in other population-based studies, including those assessing sleep in urban populations. In urban German population the prevalence of poor sleepers was 37.2% [24]. In residents of an urban community of Shanghai, the prevalence rate was 41.5%, although in the population aged 60 years and more [25]. Thirty-seven percent of an urban population in Tehran (Iran) were estimated as poor sleepers [26]. We can hypothesize, that the relatively higher rate of poor sleepers in the current study may reflect

Table 3. Comparison of the demographic and health variables in the good and poor sleepers.

	Good sleepers *n* = 225	Poor sleepers *n* = 170	Statistics
Age (Median, IQR)	37.0 (18.0)	39.5 (20.0)	z = -1.718, p = 0.086ǂ
Gender *n* (%)			
Female	154 (57.7)	113 (42.3)	$\chi^2(1)$ = 0.172, p = 0.678^
Male	71 (55.5)	57 (44.5)	
Marital status *n* (%)			
married/cohabiting	150 (55.6)	120 (44.4)	$\chi^2(1)$ = 0.688, p = 0.407^
single/divorced/widowed	75 (60)	50 (40)	
Education *n* (%)			
High school	15 (46.9)	17 (53.1)	$\chi^2(2)$ = 2.704, p = 0.259^
College	22 (50)	22 (50)	
University	188 (58.9)	131 (41.1)	
Employment status *n* (%)			
employed	165 (60.7)	107 (39.3)	$\chi^2(1)$ = 4.877, p = 0.027^
unemployed	60 (48.8)	63 (51.2)	
Economic status *n* (%)			
Very bad	2 (15.4)	11 (84.6)	$\chi^2(4)$ = 61.823, p = 0.000^
Bad	13 (21.7)	47 (78.3)	
Average	102 (56.7)	78 (43.3)	
Good	78 (73.6)	28 (26.4)	
Very good	30 (83.3)	6 (16.7)	
BMI (Median, IQR)	24.24 (7.01)	24.89 (6.58)	z = -1.578, p = 0.115ǂ
BDI-SF (Median, IQR)	2.0 (4.0)	5.0 (8.0)	z = -7.914, p = 0.000ǂ

Notes: ǂ - Statistics based on the Mann-Whitney test; ^ - Statistics based on the chi-square test. BDI-SF, Beck Depression Inventory-Short Form; BMI, Body Mass Index; IQR, Interquartile Range.

Table 4. Logistic regression results for sleep quality

	OR	95% CI	*p* value
Employment status			
employed	1.00	Reference category	
unemployed	0.82	0.49-1.38	0.455
Economic status			
Very good	1.00	Reference category	
Good	1.20	0.43-3.33	0.729
Average	2.70	1.04-7.02	0.042
Bad	11.87	3.88-36.32	0.000
Very bad	11.22	1.81-69.67	0.009
BDI-SF	1.27	1.18-1.37	0.000
Age	1.00	0.98 -1.03	0.807

Data are presented as odds ratio (OR) and 95% confidence interval (CI). BDI-SF, Beck Depression Inventory-Short Form.

important socio-economic, demographic and/or political changes that have been undergoing in Georgia in the past few decades. The strong element supporting this hypothesis is the observation that the most significant predictor of sleep quality in the studied population was one of the social determinants: the participants' economic status. This result also corroborates with a large number of studies showing that sleep problems are strongly influenced by socio-demographic factors [12, 27]. However, the economic status itself is probably not the unique determinant factor of sleep quality. Data from 8 Asian and African countries found a remarkable variation in the prevalence of sleep problems across the different countries that could not be entirely explained by poverty [28]. Given the much lower education level in those countries, compared to Georgia (lower-middle income country) our study provides supportive evidence that sleep quality might be patterned by various aspects of socioeconomic status and these aspects may differ across countries. These data further emphasize the importance of assessment of different social determinants in the sleep epidemiologic studies.

In this context, the high level of education of the studied population deserves commenting. A UNESCO report indicate that 30.17% of Georgian population aged 25 years or older completed at least bachelor's or equivalent level of education [29]. However, Tbilisi, with twice as many universities and colleges than as all other remaining regions, has the best-qualified and well-educated population. Kutaisi, has the second highest number of educational facilities [18]. Moreover, it has been found that urban students are substantially overrepresented within the higher education students - they composited about 81% of admitted cohorts between 2005 and 2009 [30]. Consequently, "over education" of the studied sample characterizes urban Georgian population, and most likely do not reflect the education pattern of rural Georgians. Whether this different pattern would affect the rate of poor sleepers needs to be explored in future nationwide surveys.

The results of our study indicate, that mood is another factor influencing the sleep duration and quality: the depression score was second, less strong, predictor of poor sleep. The correlation between sleep and depression and economic level is well known [27, 31, 32]. It has even been suggested that sleep may be a mediating mechanism through which socioeconomic status is associated with poor health [32, 33]. Therefore, addressing the social inequalities in sleep may be an important step toward targeting social inequalities in mental health.

When analyzing the type of sleep complaint, the most frequent reason of sleep disturbances in our study was the sleep maintenance problem. It is well known that sleep continuity problems may be caused by different sleep disorders (e.g., insomnia, sleep related breathing disorders, *etc*.), and the prevalence rate of such disorders in the Georgian population should be explored separately.

Regarding the gender effect, although the PSQI score was higher in females, the fact that the sleep quality and sleep disturbances measured by the PSQI did not show a significant gender effect, as frequently reported in the literature, is most likely related to the unequal gender distribution in our study population, thus emphasizing the need for further investigations in larger population-based samples. However, we found the PSQI global score was associated with age that corroborates with other studies about the effect of age on sleep quality [13, 19, 24, 26].

The effect of loneliness on subjective and objective sleep quality has been reported across age groups [34, 35]. However, no correlation between marital status and sleep quality was found in the present study. The possible reason for these differences might be the fact that the majority of single persons in our study sample belonged to the youngest age group. In addition, some cultural context of tight family support in Georgia may also play a role.

In the present investigation, 10.6% of subjects were found to take sleep medication. Further, 7% did so less than once a week. Thus, in general, the percentage of sleep medication intake in the Georgian population is relatively lower than in other countries [10-13]. We assume that this low rate of sleep medication intake does not actually reflect a low rate of sleep problems but is more likely related to the low level of sleep medicine practice in the country. That is, people in Georgia often do not report having sleep problems to medical practitioners; moreover, most of the general population are not aware that sleep problems are significant health concerns. One possible explanation for the low rate of medication consumption could also be the use of some of the traditional/herbal remedies without considering them as medications.

The sleep habits of the studied population were consistent with the data reported for other countries [9, 11, 13, 28, 36]. As expected, sleep latency was longest in the oldest group. The gender effect on sleep latency was significant, with females reporting a longer duration. In a large epidemiological study of chronotypes, it has been reported that a person's chronotype is age- and sex-dependent [37]. Maximum "lateness" is reached at around the age of 20 years; thereafter, the chronotype progressively advances with increasing age. In addition, the changes differ by gender with males being later chronotypes than females between the ages of 20 and 52 years. Aging was strongly associated with a shift towards morningness in a recent study of sleep in subjects without sleep disorders [38]. Our data are consistent with these findings. We found that subjects 20-29 years old reported significantly later bedtimes and later times of getting up compared with the other age groups, whereas the earliest bedtimes and rise times were found among ages 50-60 years. The gender effect on bedtime and rise time was also significant for the youngest population.

Decreased sleep duration is a widespread concern in modern societies. In the present study, the mean sleep duration was 6.86 hours (± 0.96 h), and sleep duration was found to decrease with age that are comparable with the results of other studies [9, 10, 12, 13, 36, 39]. The high percentage of people with short sleep duration (≤ 6 h) observed in this study may reflect variations in modern lifestyles as well as the pressure to follow, perform, and succeed in a changing political and economic environment associated with the independence of the country. In fact, in addition to the age effect, sleep duration was found to be weakly but significantly associated with depression and economic status.

Limitations and strengths of the study

Our study has several limitations that should be considered. The main limitations are the small sample size and the representativeness of the sample. We acknowledge the fact that the non-probability sampling technique makes it difficult to define the extent to which our sample actually represents the entire urban Georgian population. However, sampling through several waves, with the self-selection sampling strategy at many different locations of two largest cities, which have the highest shares in urban population of the country [18], reduces the probability that the results from this sample differ significantly from the results from the entire urban population.

Second, we present only data on sleep quality and additional measures about the prevalence of specific sleep disorders are not discussed. In addition, some important predisposing factors of poor sleep were not assessed. However, without any published evidence of the prevalence of sleep disturbances in the country, our main objective for this paper was to focus on the presence of sleep problems overall, at first. We intended to show results that are more relevant to public health than for clinical practice. Hence we report PSQI data that is sufficiently precise tool to assess multiple dimensions of sleep. Follow-up publications from the Georgia Somnus study will address the other measures of sleep disturbances.

Furthermore, the study is limited by the unequal gender distribution of the sample that could potentially impact our results. Further research with larger, gender balanced samples are needed. In addition, we did not find any correlation with sleep quality and education status. Further studies are needed to clarify whether this pattern of relationship reflects the "over education" or some cultural/ethnic context of the studied sample.

Despite these limitations, the present study is the first research on sleep habits and sleep quality in Georgia. The strength of the study is that data were collected through face-to-face interviews. Our findings indicate that a problem of sleep disturbances in the Georgian population exists and needs to be examined in more depth. However, additional studies, with random sampling, bigger sample size and rural population included are necessary to come up with a reliable assessment of the burden of sleep problems and the nature of socio-economic determinates of sleep disturbances in the Georgian population, to draw the attention of health care professionals to the clinical significance of the problem; to identify, diagnose, and treat individuals with sleep disorders, to prevent and/or improve their health outcomes and thus strengthen sleep-related health care in the country.

More broadly, this study calls for serious attention of public health authorities to the magnitude of sleep-related health problems in those countries where the field of sleep medicine is not well developed. Because of the critical role of sleep for health, the examination of sleep in different socio-economic, cultural and ethnic populations not only serves as a reference point in responding to the challenges of sleep medicine development in many areas of the world, but may also contribute to the better understanding of the role of sleep in public health disparities and therefore, would facilitate elimination of health inequities.

Acknowledgments

Conflict of interest statement: The authors declare that they have no actual or potential financial, personal or professional conflicts of interest. This study was supported by Swiss National Science Foundation, program SCOPES, Institutional Partnership Project IZ74Z0_137415. We thank the subjects who participated in the study for their cooperation.

References

[1] Bixler E., Sleep and society: an epidemiological perspective, Sleep Med., 2009, 10, 3-6

[2] Colten H., Altevogt B., Sleep disorders and sleep deprivation: an unmet public health problem, National Academies Press, Washington, DC, USA, 2006

[3] Walsh J.W., Dement W.C., Dinges D.F., Sleep medicine, public policy and public health, In: Kryger M.H., Roth T., Dement W.C. (Eds.) Principles and practice of sleep Medicine, 5th ed., Elsevier, Philadelphia, 2011, 716-724

[4] Baglioni C., Battagliese G., Feige B., Spiegelhalder K., Nissen C., Voderholzer U., et al., Insomnia as a predictor of depression: a meta-analytic evaluation of longitudinal epidemiological studies, J. Affect. Disord., 2011, 135, 10-19

[5] Banks S., Dinges D.F., Behavioral and physiological consequences of sleep restriction, J. Clin. Sleep Med., 2007, 3, 519-528

[6] Gottlieb D.J., Redline S., Nieto F.J., Baldwin C.M., Newman A.B., Resnick H.E., et al., Association of usual sleep duration with hypertension: the Sleep Heart Health Study, Sleep, 2006, 29, 1009-1014

[7] Priou P., Le Vaillant M., Meslier N., Paris A., Pigeanne T., Nguyen X.L., et al., Cumulative association of obstructive sleep apnea severity and short sleep duration with the risk for hypertension, PLoS One, 2014, 9, e115666

[8] Spiegel K., Tasali E., Leproult R., Van Cauter E., Effects of poor and short sleep on glucose metabolism and obesity risk, Nat. Rev. Endocrinol., 2009, 5, 253-261

[9] Groeger J.A., Zijlstra F.R., Djik D.J., Sleep quantity, sleep difficulties and their perceived consequences in a representative sample of some 2000 British adults, J. Sleep Res., 2004, 13, 359-371

[10] National Sleep Foundation, Sleep in America poll: summary findings, National Sleep Foundation, Washington, DC, USA, 2010

[11] Ohayon M., Epidemiological study on insomnia in the general population, Sleep, 1996, 19, 7-15
[12] Stringhini S., Haba-Rubio J., Marques-Vidal P., Waeber G., Preisig M., Guessous I., et al., Association of socioeconomic status with sleep disturbances in the Swiss population-based CoLaus study, Sleep Med., 2015, 16, 469-476
[13] Tribl G.G., Schmeiser-Rieder A., Rosenberger A., Saletu B., Bolitschek J., Popovic R., et al. Sleeping habits in the Austrian population, Sleep Med., 2002, 3, 21-28
[14] Basishvili T., Eliozishvili M., Maisuradze L., Lortkipanidze N., Nachkebia N., Oniani T., et al., Insomnia in a displaced population is related to War-associated remembered stress, Stress Health, 2012, 28, 186-192
[15] Kuchukhidze G., Toidze I., Khatiashvili I., Maisuradze L., Frauscher B., Kasradze S., et al., Prevalence of restless legs syndrome in a Georgian primary healthcare setting: a pilot study, Eur. Neurol., 2012, 68, 177-180
[16] Maïsuradze L., Lortkipanidze N., Eliozishvili M., Gvilia I., Darchia N., Posttraumatic stress disorder and insomnia development in individuals escaped from Shida Kartli, Georgia, Georgian Med. News, 2010, 180, 64-69
[17] National Statistics Office of Georgia – GeoStat. Available at: http://www.geostat.ge/ (accessed in May 2016)
[18] World Bank, Georgia Urbanization review. Toward an Urban Sector Strategy Georgia's Evolving Urban System and its Challenges. Available at: http://documents.worldbank.org/curated/en/2013/02/19319449/georgia-urbanization-review-toward-urban-sector-strategy-georgias-evolving-urban-system-challenges, 2013 (accessed in May 2016)
[19] Doi Y., Minowa M., Uchiyama M., Okawa M., Subjective sleep quality and sleep problems in the general Japanese adult population, Psychiatry Clin. Neurosci., 2001, 55, 213-215
[20] Yunus F.M., Khan S., Akter T., Jhohura F.T., Reja S., Islam A., et al., How many hours do people sleep in Bangladesh? A country representative survey, Sleep Res., 2016, 25, 365-376
[21] Buysse D.J., Reynolds C.F. 3rd, Monk T.H., Berman S.R., Kupfer D.J., The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research, Psychiatry Res., 1989, 28, 193-213
[22] Beck A.T., Beck R.W., Screening depressed patients in family practice: a rapid technique, Postgrad. Med., 1972, 52, 81-85
[23] Billiard M., Insomnia associated with medical disorders, In: Billiard M. (Ed.) Sleep: physiology, investigations and Medicine, Kluwer Academic, Plenum Press, New York, USA, 2003, 221-226
[24] Anders M.P., Breckenkamp J., Blettner M., Schlehofer B., Berg-Beckhoff G., Association between socioeconomic factors and sleep quality in an urban population-based sample in Germany, Eur. J. Public Health, 2014, 6, 968-973
[25] Luo J., Zhu G., Zhao Q., Guo Q., Meng H., Hong Z., et al., Prevalence and risk factors of poor sleep quality among Chinese elderly in an urban community: results from the Shanghai Aging Study, PLoS One, 2013, 8, e81261
[26] Asghari A., Farhadi M., Kamrava S.K., Ghalehbaghi B., Nojomi M., Subjective sleep quality in urban population, Arch. Iran. Med., 2012, 15, 95-98
[27] Grandner M.A., Patel N.P., Gehrman P.R., Xie D., Sha D., Weaver T., et al., Who gets the best sleep? Ethnic and socioeconomic factors related to sleep complaints, Sleep Med., 2010, 11, 470-478
[28] Stranges S., Tigbe W., Gómez-Olivé F.X., Thorogood M., Kandala N.B., Sleep problems: an emerging global epidemic? Findings from the INDEPTH WHO-SAGE study among more than 40,000 older adults from 8 countries across Africa and Asia, Sleep, 2012, 35, 1173-1181
[29] UNESCO Institute for Statistics. Available at: http://data.uis.unesco.org/index.aspx?queryid=168, 2015 (accessed in May 2016)
[30] Chankseliani M., Rural disadvantage in Georgian higher education admissions: a mixed-methods study, Comp. Educ. Rev., 2013, 57, 424-456
[31] Adrien J., Neurobiological bases for the relation between sleep and depression, Sleep Med. Rev., 2002, 6, 341-351
[32] Moore P.J., Adler N.E., Williams D.R., Jackson, J.S., Socioeconomic status and health: the role of sleep, Psychosom. Med., 2002, 64, 337-344
[33] Arber S., Bote M., Meadows R., Gender and socio-economic patterning of self-reported sleep problems in Britain, Soc. Sci. Med., 2009, 68, 281-289
[34] Kurina L.M., Knutson K.L., Hawkley L.C., Cacioppo J.T., Lauderdale D.S., Ober C., Loneliness is associated with sleep fragmentation in a communal society, Sleep, 2011, 34, 1519-1526
[35] McHugh J.E., Lawlor B.A., Perceived stress mediates the relationship between emotional loneliness and sleep quality over time in older adults, Br. J. Health Psychol., 2013, 3, 546-555
[36] Ohayon M.M., Carskadon M.A., Guilleminault C., Vitiello M.V., Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: developing normative sleep values across the human lifespan, Sleep, 2004, 27, 1255-1273
[37] Roenneberg T., Kuehnle T., Juda M., Kantermann T., Allebrandt K., Gordijn M., et al., Epidemiology of the human circadian clock, Sleep Med. Rev., 2007, 11, 429-438
[38] Luca G., Haba Rubio J., Andries D., Tobback N., Vollenweider P., Waeber G., et al., Age and gender variations of sleep in subjects without sleep disorders, Ann. Med., 2015, 47, 482-491
[39] Léger D., Beck F., Richard J.B., Sauvet F., Faraut B. The risks of sleeping "too much". Survey of a National Representative Sample of 24671 Adults (INPES Health Barometer), PLoS One, 2014, 9, e106950