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Impact of common diseases and habits on daytime sleepiness in adults

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Abstract

We aimed to investigate the impact of common diseases and habits on daytime sleepiness in adults.

We retrospectively collected the clinical and overnight polysomnographic data of 2829 adults. The impact of common diseases and habits on the Epworth Sleepiness Scale (ESS) score was analyzed by univariate and multivariate linear regression analyses.

The mean ESS score was 6.2 (standard deviation = 4.3; range = 0–24) for all adults. Multivariate linear regression analysis showed that dyslipidemia, acute myocardial infarction (AMI), liver cirrhosis, alcohol drinking, and tea consumption had a significantly positive association with ESS score for all adults after adjusting for age, sex, body mass index, apnea–hypopnea index, sleep efficiency, percentage of sleep N3 stage, and depression. Subgroup analysis by sex showed that AMI, liver cirrhosis, alcohol drinking, and tea consumption had significantly positive association with ESS scores in males, whereas only dyslipidemia had significantly positive association with ESS scores in females. Subgroup analysis by age showed that alcohol drinking had a significantly positive association with ESS scores in young adults. AMI had a significantly positive association with ESS scores, but chronic kidney disease had a significantly negative association with ESS scores in middle-aged adults. Furthermore, dyslipidemia, chronic kidney disease, and cancers had a significantly positive association with ESS scores in older adults.

Dyslipidemia, AMI, liver cirrhosis, alcohol drinking, and tea consumption had a significantly positive association with daytime sleepiness in adults but differed by sex and age.

Abbreviations: AMI = acute myocardial infaction, CKD = chronic kidney disease, EDS = excessive daytime sleepiness, ESS = Epworth Sleepiness Scale, OSA = obstructive sleep apnea.

Keywords: common diseases, Epworth Sleepiness Scale, habits, polysomnography

1. Introduction

Excessive daytime sleepiness (EDS) is very common in children and adults. EDS might interfere memory, learning and working efficiency severely, and increase the risk of accidents.[1] EDS is a complex disease with many etiologies. For example, ethnicity, sex, body morphometry, obstructive sleep apnea (OSA), depression, and lack of regular exercise were related to EDS.[1–3] Also, sleep efficiency, sleep latency, and gasping/choking were related to EDS.[1] However, Sforza et al[4] reported that only gender, body mass index (BMI), and depression were significantly related to EDS in the elderly.

The Epworth Sleepiness Scale (ESS) is a very common questionnaire for assessing EDS in the world. The ESS score (the sum of 8 items score: 0–3) can range from 0 to 24, and an ESS score >10 suggests different levels of EDS. However, some researchers criticized its clinical use due to low test–retest reliability[5] and its ambiguity of items and cultural understanding.[6,7] Although the Chinese version of the ESS was found to have well reliability and validity for Mandarin-speaking Taiwanese.[8]

Although some risk factors for EDS were reported, the impact of many common diseases and habits on the EDS was still unclear. Thus, in this study, we aimed to investigate the impact of hypertension, diabetes mellitus, dyslipidemia, chronic kidney disease (CKD), liver cirrhosis, acute myocardial infarction (AMI), stroke, cancers, smoking, drinking, and coffee and tea consumption on the ESS scores in adults by a larger database in Taiwan.

2. Methods

From November 2011 to June 2017, clinical and overnight polysomnographic (PSG) data of 2829 patients who were >20 years with sleep disturbance at Dalin Tzu Chi Hospital were collected retrospectively. This study was approved by

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All data generated or analyzed during this study are included in this published article [and its supplementary information files].

The study was approved by The Research Ethics Committee of Dalin Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation (No. B10604018).

The authors declare no competing interests.

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the Research Ethics Committee of Dalin Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation (no. B10604018). The informed consent was waived because the study was a retrospective data analysis.

Clinical data including ESS score, age, sex, BMI, hypertension, diabetes mellitus, dyslipidemia, AMI, stroke, CKD, liver cirrhosis, cancers, depression, smoking, drinking, and coffee and tea consumption were recorded. Also, apnea–hypopnea index (AHI), sleep efficiency, and percentage of sleep N3 stage, which were acquired during PSG examination, were included for analysis. Common diseases and health-related habits were graded as "no" and "yes." The ESS score was treated as a continuous dependent variable during analysis.

2.1. Statistical analysis

Univariate linear regression was used first to test the associations of common diseases and habits on the ESS scores individually in all adults. Then, multivariate linear regression was used to test the associations of common diseases and habits on the ESS scores with adjustment of age, sex, BMI, AHI, sleep efficiency, percentage of sleep N3 stage, and depression in all adults (20–91 years old). In addition, subgroup analysis was performed on different sex and age populations (20–39, 40–59, and >60 years). All analyses were performed using STATA 10.0 software (Stata Corp, College Station, TX). A P value of <.05 was considered to be significant.

3. Results

Table 1 shows the basic characteristics of all adults. The mean age was 50.8 years (standard deviation [SD] = 13.1) for all adults. There were 1851 males and 978 females. The mean BMI was 26.5 kg/m^2 (SD = 4.7) for all adults. The mean AHI was 28.1/h (SD = 23.9), mean sleep efficiency was 75.5% (SD = 15.9), and mean percentage of sleep N3 stage was 1.6% (SD = 3.9) for all adults. And, the mean ESS score was 6.2 (SD = 4.3; range = 0–24) for all adults. In addition, the number of suffering from common diseases and having habits are shown in Table 1.

Table 2 shows the results of association between each clinical variables and ESS scores individually by univariate linear regression analysis. We found that hypertension, diabetes mellitus, dyslipidemia, AMI, CKD, liver cirrhosis, smoking, drinking, and coffee and tea consumption had a significantly positive association with ESS scores in all adults. In addition, sex, BMI, AHI, and sleep efficiency had a significantly positive association with ESS scores individually, too.

Table 3 shows the association of common diseases and habits on the ESS scores after adjusting for other variables by multivariate linear regression analysis. We found that dyslipidemia, AMI, liver cirrhosis, alcohol drinking, and tea consumption had significantly positive association with ESS scores in all adults. Subgroup analysis by sex showed that AMI, liver cirrhosis, alcohol drinking, and tea consumption had significantly positive association with ESS scores in males, whereas only dyslipidemia had significantly positive association with ESS scores in females.

Table 4 shows the association of common diseases and habits on the ESS scores in adults of different ages after adjusting for other variables by multivariate linear regression analysis. In young adults, hypertension was positively associated with ESS scores with a borderline significance, whereas alcohol drinking had a significantly positive association with ESS scores. In middle-aged adults, AMI had a significantly positive association with ESS scores, but CKD had a significantly negative association with ESS scores. Besides, liver cirrhosis was positively associated with ESS scores with a borderline significance. Furthermore, in older adults, dyslipidemia, CKD, and cancers had a significantly positive association with ESS scores, whereas tea consumption was positively associated with ESS scores with a borderline significance.

Table 1

Basic characteristics for all adults.

	All subjects (20–91 yr, N = 2829)
Mean age, yr (SD)	50.8 (13.1)
Males/females	1851/978
Mean ESS score (SD; range)	6.2 (4.3; 0–24)
BMI, kg/m^2 (SD)	26.5 (4.7)
AHI, /h (SD)	28.1 (23.9)
Sleep efficiency, % (SD)	75.5 (15.9)
Percentage of sleep N3 stage, % (SD)	1.6 (3.9)
Depression	411
Hypertension	913
Diabetes mellitus	309
Dyslipidemia	454
AMI	70
Stroke	63
CKD	87
Liver cirrhosis	24
Cancers	106
Smoking	537
Drinking	1107
Coffee	1957
Tea	2242

AHI = apnea–hypopnea index, AMI = acute myocardial infarction, BMI = body mass index, CKD = chronic kidney disease, ESS = Epworth Sleepiness Scale, SD = standard deviation.

Table 2

Univariate linear regression for each clinical variables on ESS scores.

Clinical variables	All subjects (20–91 yr, N = 2829), coefficient ± SE (P value)
Age	0.0012 ± 0.0061 (.841)
Sex	1.1955 ± 0.1679 (<.001)
BMI	0.1273 ± 0.0169 (<.001)
AHI	0.0390 ± 0.0033 (<.001)
Sleep efficiency	0.0120 ± 0.0051 (.018)
Percentage of sleep N3 stage	–0.0279 ± 0.0204 (.171)
Depression	0.1359 ± 0.2284 (.552)
Hypertension	0.8108 ± 0.1721 (<.001)
Diabetes mellitus	0.7277 ± 0.2584 (.005)
Dyslipidemia	1.0169 ± 0.2195 (<.001)
AMI	1.7798 ± 0.5155 (.001)
Stroke	0.8793 ± 0.5458 (.107)
CKD	1.2009 ± 0.4653 (.010)
Liver cirrhosis	2.5765 ± 0.8784 (.003)
Cancers	0.2574 ± 0.4247 (.544)
Smoking	0.7722 ± 0.2050 (<.001)
Drinking	0.8323 ± 0.1644 (<.001)
Coffee	0.5810 ± 0.1741 (.001)
Tea	1.0363 ± 0.1976 (<.001)

AHI = apnea–hypopnea index, AMI = acute myocardial infarction, BMI = body mass index, CKD = chronic kidney disease, ESS = Epworth Sleepiness Scale, SE = standard error.

4. Discussion

This cross-sectional study aimed to investigate the association of common diseases and habits with daytime sleepiness using a large clinical and overnight PSG data. We found that their association differed by sex and age. First, AMI, liver cirrhosis, alcohol drinking, and tea consumption had significantly positive association with ESS scores in males, whereas only dyslipidemia had significantly positive association with ESS scores in females. Second, alcohol drinking had a significantly positive association with ESS scores in young adults; AMI had a significantly positive association with ESS scores, but CKD had a significantly negative association with ESS scores in middle-aged adults;

Table 3

Association of common diseases and habits on ESS scores after adjusting for other variables by multivariate linear regression in all adults and in different sex.

Variables	All adults	Male adults Coefficient ± SE (*P* value)	Female adults
Hypertension	0.1752 ± 0.1966 (.373)	0.0750 ± 0.2473 (.762)	0.3288 ± 0.3281 (.317)
Diabetes mellitus	0.2305 ± 0.2756 (.403)	0.2776 ± 0.3488 (.426)	–0.0785 ± 0.4569 (.864)
Dyslipidemia	0.5569 ± 0.2334 (.017)	0.3629 ± 0.2915 (.213)	0.9650 ± 0.3980 (.016)
AMI	1.4404 ± 0.5408 (.008)	1.6234 ± 0.6030 (.007)	0.6746 ± 1.4429 (.640)
Stroke	–0.0574 ± 0.5526 (.917)	0.3916 ± 0.6556 (.550)	–1.8748 ± 1.0766 (.082)
CKD	0.3276 ± 0.4844 (.449)	0.4937 ± 0.5913 (.404)	–0.1198 ± 0.8733 (.891)
Liver cirrhosis	2.2854 ± 0.9110 (.012)	2.5501 ± 1.0826 (.019)	1.4786 ± 1.7861 (.408)
Cancers	0.4450 ± 0.4278 (.298)	0.0146 ± 0.6020 (.981)	0.7731 ± 0.6032 (.200)
Smoking	0.2091 ± 0.2208 (.344)	0.1816 ± 0.2417 (.453)	–0.1400 ± 0.6550 (.831)
Drinking	0.3702 ± 0.1848 (.045)	0.4431 ± 0.2162 (.041)	0.3292 ± 0.3817 (.389)
Coffee	0.1518 ± 0.2019 (.798)	0.1228 ± 0.2593 (.636)	0.1006 ± 0.3217 (.755)
Tea	0.5680 ± 0.2295 (.013)	0.6674 ± 0.3156 (.035)	0.5353 ± 0.3350 (.110)

AHI = apnea–hypopnea index, AMI = acute myocardial infarction, BMI = body mass index, CKD = chronic kidney disease, ESS = Epworth Sleepiness Scale, SE = standard error.

dyslipidemia, CKD, and cancers had a significantly positive association with ESS scores in older adults.

EDS is a common complex disease with many risk factors and underlying mechanisms. In the literature, the relationship between ESS score and OSA was reported with inconsistent results.[3] On the other hand, the risk factor for EDS was rarely discussed. EDS was reported to be affected by ethnicity, gender, obesity, OSA, depression, and lack of regular exercise previously.[1–3] Besides, age, sleep latency, sleep efficiency, gasping/choking, arousal index, AHI, mean oxygen saturation during sleep, and percentage of oxygen saturation <90% during sleep had differential impact on the daytime sleepiness.[1] However, Sforza et al[4] found that only gender, BMI, and depression were significantly related to daytime sleepiness in the elderly. Chung[8] reported that AHI and minimum oxygen saturation during sleep were not correlated with ESS score. Now, we found that some common diseases and habits were associated with daytime sleepiness after adjusting many well-known clinical factors.

The underlying mechanisms linking dyslipidemia, AMI, liver cirrhosis, alcohol drinking, or tea consumption and EDS might be complex. Dyslipidemia might lead to metabolic dysfunctions, atherosclerosis, and poor organ perfusion. AMI might lead to heart failure and poor organ perfusion. Liver cirrhosis or CKD might present with metabolic dysfunction, hepatic encephalopathy, or uremia. Cancers might result in cachexia. All above-mentioned disturbances might be related to EDS. Besides, it was reasonable to see that alcohol drinking was positively related to ESS scores because alcohol had sedative effect and increased EDS whether it was drunk in the daytime or in the evening. On the contrary, the opposite association between tea consumption and ESS scores might be explained by a compensating effect. It was possible that subjects with EDS tended to drink tea, which was more popular than coffee habit in Taiwan. Thus, tea consumption was positively, but not negatively, associated with ESS scores. However, it is strange to see a negative association between CKD and ESS scores in middle-aged adults. We supposed that the severity/duration of CKD in middle-aged adults might be too mild to lead to daytime sleepiness; otherwise, middle-aged subjects with CKD maybe do more exercise to keep them alert in the daytime.

This study had both strengths and weaknesses. First, a large number of cases and a wide range of age, sleep parameters and ESS scores were included. Thus, our results might be applied to general population. Second, analyses included statistical adjustment for many important well-known factors. So, our results could be very presentative for this issue. The weak points of this study include, first, that the severity and duration of common diseases or habits were not recorded. Thus, the dose–response relationship between common diseases or habits and ESS scores could not be assessed in this study. Second, some other unknown clinical factors might also have affected our results. Third, over adjustment might be present between dyslipidemia, AMI, alcohol drinking, or tea and AHI; between dyslipidemia, AMI, liver cirrhosis, alcohol drinking, or tea and sleep efficiency; and between

Table 4

Association of common diseases and habits on ESS scores in adults of different ages after adjusting for other variables by multivariate linear regression.

Variables	Young (20–39 yr)	Middle aged (40–59 yr) Coefficient ± SE (*P* value)	Older (≥60 yr)
Hypertension	1.0541 ± 0.5448 (.054)	0.2241 ± 0.2642 (.397)	–0.4016 ± 0.3586 (.263)
Diabetes mellitus	1.1659 ± 0.8632 (.177)	0.6568 ± 0.4187 (.117)	–0.1729 ± 0.4185 (.680)
Dyslipidemia	0.8447 ± 0.7369 (.252)	0.1096 ± 0.3107 (.724)	0.9668 ± 0.4206 (.022)
AMI	3.7446 ± 2.3110 (.106)	2.5145 ± 0.9812 (.010)	0.0437 ± 0.7012 (.950)
Stroke	–2.1998 ± 0.2668 (.332)	–0.2589 ± 1.0944 (.813)	0.1270 ± 0.6866 (.853)
CKD	2.2035 ± 1.7898 (.219)	-2.2469 ± 0.7618 (.003)	2.3207 ± 0.7003 (.001)
Liver cirrhosis	2.4242 ± 2.8061 (.388)	2.7229 ± 1.4794 (.066)	2.1818 ± 1.2899 (.091)
Cancers	–0.3131 ± 1.6973 (.854)	–0.8993 ± 0.6473 (.165)	1.8539 ± 0.6168 (.003)
Smoking	–0.0226 ± 0.3934 (.954)	0.1607 ± 0.2956 (.587)	0.6540 ± 0.5962 (.273)
Drinking	0.8785 ± 0.3543 (.013)	0.1902 ± 0.2490 (.445)	0.1735 ± 0.4222 (.681)
Coffee	–0.5000 ± 0.4660 (.284)	0.2791 ± 0.2777 (.315)	–0.0293 ± 0.3844 (.939)
Tea	0.6285 ± 0.5430 (.248)	0.4717 ± 0.3220 (.143)	0.7873 ± 0.4159 (.059)

AHI = apnea–hypopnea index, AMI = acute myocardial infarction, BMI = body mass index, CKD = chronic kidney disease, ESS = Epworth Sleepiness Scale, SE = standard error.

dyslipidemia, AMI, or alcohol drinking and percentage of sleep N3 stage ($P < .05$ for each univariate linear regress analysis).

5. Conclusion

EDS was a common complex disease with many etiology. After considering age, sex, BMI, AHI, sleep efficiency, percentage of sleep N3 stage, and depression, we found that dyslipidemia, AMI, liver cirrhosis, drinking, and tea consumption had significantly positive association with daytime sleepiness in all adults. However, this association might differ by sex and age.

Author contributions

H.-H.T., J.-H.H.: wrote the initial manuscript; S.-W.H., S.-R.H.: data acquisition; J.-H.H.: conception and design, analysis and interpretation of data, and final approval of the version to be published.

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