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Excessive daytime sleepiness and metabolic syndrome: a cross-sectional study

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ABSTRACT

Objective. Excessive daytime sleepiness (EDS) has been associated with singular independent symptoms of metabolic syndrome, such as insulin resistance and diabetes. The aim of this study was to assess whether this relationship is sustained among individuals who meet criteria for the whole syndrome.

Materials/methods. 994 women aged 21–94 years (median 50.2 years, IQR 34–65) and 840 men aged 24–92 years (median 60.4 years, IQR 47–73) who resided in the Barwon Statistical Division, South-Eastern Australia, and participated in the Geelong Osteoporosis Study (GOS) between the years of 2001 and 2008. Anthropometric measurements, lifestyle, mood, demographic and health-related factors were obtained. Sleep duration was categorized as short (<6 h), average (6–9 h) and long (>9 h). Sleepiness was assessed using the Epworth Sleepiness Scale (ESS), and scores of ≥ 10 indicated EDS. The presence of metabolic syndrome was assessed using a modified version of criteria as outlined by the International Diabetics Federations recommendations (2005).

Results. Women: 138 (14.0%) of the women reported EDS; those with EDS were heavier, had a greater body mass index (BMI) and were more likely to have metabolic syndrome. The association between EDS and metabolic syndrome was sustained following adjustment for age and hours sleep (adjusted OR = 1.90, 95% CI 1.16–3.09), however BMI attenuated the relationship (adjusted OR = 1.64, 95% CI =1.05–2.57). These findings were independent of smoking status, alcohol intake, medication use, socioeconomic status, physical activity and current diagnosis of a depressive illness. *Men*: 111 (13.2%) of the men reported EDS; those with EDS had a greater waist circumference and were more likely to have metabolic syndrome. Analysis of age-stratified data (<60 years vs. ≥60 years) revealed that the older men with EDS were more likely to have metabolic syndrome (OR = 1.71, 95% CI 1.01–2.92),

Abbreviations: ABS, Australian Bureau of Statistics; BMI, body mass index; BSD, Barwon statistical division; EDS, excessive daytime sleepiness; ESS, Epworth Sleepiness Scale; GOS, Geelong Osteoporosis Study; HDL, high-density lipoprotein; IRSAD, Index of Relative Socio-Economic Advantage and Disadvantage; MDD, major depressive disorder; OSA, obstructive sleep apnea; SCID-I/NP, Structured Clinical Interview for DSM-IV-TR Research Version, Non-patient edition; SEIFA, Socio-economic Index for Areas; WHR, waist to hip ratio.

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however, age explained this association (age adjusted OR = 1.51, 95% CI 0.88–2.60). In the younger age group, no association was detected between EDS and metabolic syndrome. For both men and women, the prevalence of combined EDS and metabolic syndrome increased progressively with age.

Conclusion. For women, the association between EDS and metabolic syndrome appears to be driven by adiposity measures; while for men, the association is somewhat attributed to older age. Additional research is required to assess temporal associations with underlying sleep pathology.

1. Introduction

Excessive daytime sleepiness (EDS) is common among adults, with recent local estimates suggesting that as many as one-third of the adult population experiences these symptoms [1]. The sleep-related disorder, obstructive sleep apnea (OSA), is the most commonly linked condition associated with EDS among both clinical [2] and population-based samples [3]. The daytime symptoms experienced by these individuals are often attributed to the degree of nocturnal impairment characteristic of the disorder, such as periods of hypoxemia or sleep fragmentation [4]. Despite this, some studies have found a poor correlation between measures of OSA disease severity and symptoms of EDS [5,6], and have instead suggested that symptoms of EDS may be related to other factors associated with OSA, such as obesity [7]. These symptoms similarly appear associated with a number of independent factors, such as sleep restriction [6] and/or associated lifestyle, health or medical factors [1,8].

A large body of research has highlighted the role of several health, lifestyle and disease factors in the expression of EDS, thus indicating that the mechanism of EDS exists beyond that of underlying sleep-related pathology. There is some evidence that EDS is associated with indices of increased adiposity [6], and similar research has shown that EDS can be present in the absence of underlying sleep disordered breathing among obese individuals [9,10]. Body composition markers, in particular visceral adiposity, have previously been linked to disorders of insulin resistance and independent features of metabolic syndrome, such as type 2 diabetes and hypertension [11,12]. In addition, several studies have demonstrated that the presence of EDS is directly associated with independent features of metabolic syndrome, such as insulin resistance [13] and diabetes [6], even after controlling for sleep disordered breathing [14]. Mechanistically, such associations may have peripheral associations with a number of inflammatory processes characteristic of metabolic disturbance [13,15].

Characterizing the relationship between metabolic factors and EDS has several implications for overall health outcomes, not least in assisting with appropriate and effective treatment modalities for these patients. However, there is currently a paucity of information assessing the association between EDS and metabolic syndrome, particularly beyond that of individual symptom clusters. Therefore, the aim of the current study was to assess whether the observed relationship between EDS and metabolic syndrome is sustained among individuals who meet criteria for the syndrome among a large, population-based sample of adults, while assessing the relative contribution of associated lifestyle and health factors.

2. Methods

2.1. Participants

This cross-sectional study examined men and women who participated in the Geelong Osteoporosis Study (GOS). The GOS is a large, population based age-stratified cohort, located in south-eastern Australia. Participants were randomly-recruited using the Commonwealth electoral rolls for the Barwon Statistical Division (BSD) as a sampling frame.

Between the years of 1993 and1997, 1494 women were randomly recruited, representing a participation of 77.1% [10]. At the 10-year follow up (2004–2008), 881 women from the original sample returned (82.1%). This cohort was complemented by the inclusion of an additional 246 randomly-selected women aged between 20 and 29 years, in order to allow for the continued investigation of the full adult age range. Of the 1127 women who participated in assessments conducted during the period 2004–8, participants for whom sleep (n = 25), body composition (n = 59), or blood pressure (n = 49) data were not available were excluded; this resulted in a total of 994 women aged 21–94 years included in this analysis.

Between the years of 2001 and 2006, 1540 men were recruited (response 67.0%) [10], and have since returned for follow up (n = 978) (response 81.0%). Of the 978 men who participated in the 5-year follow up, participants for whom sleep data (n = 32), body composition (n =45) or blood pressure (n = 61) data were not available were excluded from analysis, resulting in a total of 840 men aged between 24 and 92 years eligible for this analysis. A comprehensive description of the male and female GOS cohorts and the related recruitment procedures can be found elsewhere [16].

This study was conducted with the approval of Barwon Health Human Research Ethics Committee, and written informed consent was obtained from each participant.

2.2. Measurements

2.2.1. Epworth Sleepiness Scale

EDS was assessed using the Epworth Sleepiness Scale (ESS) [17]. The ESS assesses an individual's sleep propensity and likelihood of dozing among a number of hypothetical soporific and engaging tasks via a self-administered 8-item scale [17]. Sleepiness is assessed using a 4-point Likert scale, referring to an individual's likelihood or probability of dozing in that particular situation (0 = no probability, 3 = high probability). Total scores range from 0 to 24, with higher scores reflecting higher levels of sleepiness. While there are no universally