

Relationship between sleep disorders and diabetes mellitus :a review of literature

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Abstract

Background :Body functions need good quality and quantity of sleep. Glucose regulation is affected by numerous types of sleep disorders. Shorter sleep duration was found to be associated with increase in the incidence of type 2 diabetes mellitus. Several studies link sleep deprivation with increased risk of diabetes. Through alternation of the glucose metabolism and increase obesity .

Objectives :The aims of this study were to demonstrate the relationship between sleep disorders and diabetes mellitus and to assess the pathogenesis of sleep disorders and diabetes mellitus .

Review of literature : Sleep is a biobehavioral phenomenon . That is regulated by neurohormonal process , circadian and homeostatic .

Sleep restriction affects many body functions like endocrine function, metabolic function and immunity .

Conclusion: This study found that sleep disorders have a significant role in changing of blood glucose level. The increasing of stresses in social life and occupational pressure contribute to less sleeping hours and changes in the sleeping pattern . Although it found a relationship between obstructive sleep apnea , decrease in slow wave sleep and increase risk of type 2 diabetes mellitus .

In summary, a compelling evidence from several studies confirmed the relationship between disturbance in sleep physiology as a risk factor that increases the possibility of developing type 2 diabetes mellitus.

Key words : diabetes mellitus, sleep disorders , glucose metabolism , insomnia , Obstructive sleep apnea , growth hormone, Glycated hemoglobin .

1 INTRODUCTION

Diabetes mellitus(DM) is a metabolic disorder that happens when there is no adequate amount of insulin in the body[1]. The incidence of diabetes mellitus worldwide increase from 108 million in 1980 to 422 million in 2014[2]. In Saudi Arabia, DM represents 3.4 million in 2015 which makes it one of the highest 19 countries in diabetes prevalence[3].

There are 2 types of diabetes ,type 1 diabetes mellitus which results from destruction of beta cells in the pancreas and type 2 which mainly results from insulin resistance . In insulin resistance, the pancreas produces more insulin but the body cells don't response to the insulin which lead to increase in the blood sugar[4].

The causes of diabetes mellitus type 1 are either genetic or environmental factors while the causes of type 2 are lifestyle factors

like being overweight , insufficient physical activity, diet, age and some medication types such as antihypertensive drug and high dose of corticosteroids[4] .

It was found recently that change in normal sleep pattern also can result in diabetes mellitus . Sleep disorders are a group of syndromes manifested by alternation in sleep amount and sleep pattern .Change in sleep can take many forms such as change in sleep duration, sleep apnea , slow wave sleep and shift work sleep disorders . All these disorders contribute to increase risk of diabetes by causing disturbance in glucose metabolism and increase in appetite[5],[6],[7] .

Body functions need good quality and quantity of sleep. Glucose regulation is affected by numerous types of sleep disorders. Shorter sleep duration was found to be associated with increase in the incidence of type 2 diabetes mellitus. Several studies link sleep deprivation with increased risk of diabetes. Through alternation of the glucose metabolism and increase obesity .

Another form of sleep disorder; the obstructive sleep apnea has a critical rule in changes of glucose metabolism and increase proinflammatory cytokines which increase leptin hormone that increases risk of type 2 diabetes mellitus. Also, less slow wave sleep are associated to increase type 2 diabetes mellitus through decrease insulin sensitivity and blood glucose level[8] .

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These alternation in metabolism of the glucose might be associated with the hypothalamic –secretory axis .Changes in secretion of cortisol , counter regulatory hormones and growth hormone (GH) ,might be linked to alternation in glucose metabolism during the depravation of sleeping . Growth hormone (GH) is secreted in the blood by the anterior pituitary gland .Growth hormone play important rule in the metabolism , maintaining the blood glucose level within the normal level and maintain normal body structure . In addition , sleep deprivation were linked to increase the evening level of cortisol and increase the nighttime growth hormone level . Also , prolonged exposure of peripheral tissues to greater growth hormone level might be linked to reduction of glucose uptake by the muscles. That's affect glucose metabolism . Also, increase the concentration of cortisol are linked to decrease the insulin sensitivity[7]. There are 2 hormones control food intake , leptin which is an appetite-inhibiting hormone that stimulates feelings of satiety. The other hormone is ghrelin which increases food intake .It was found that the leptin hormone decreases in sleep restriction .The alteration in the ratio of ghrelin-to-leptin was powerfully connected to the alteration in hunger ratings, suggesting that the alterations detected in these appetite hormones was incompletely responsible for the increase in appetite and hunger. All these contribute to be risks of diabetes mellitus type 2 . This study , will focus on sleep disorders as a risk factor of diabetes[7].

2 Objectives

The aims of this study were to demonstrate the relationship between sleep disorders and diabetes mellitus and to assess the pathogenesis of sleep disorders and diabetes mellitus .

3 Review of literature

Sleep is a biobehavioral phenomenon . That is regulated by neurohormonal process , circadian and homeostatic [9]. Sleep restriction affects many body functions like endocrine function, metabolic function and immunity .There are several studies reported a link between sleep disorders and type 2 diabetes mellitus .

In this study we will shed light on the role of sleep amount, quality of sleep , sleep apnea , loss slow wave sleep and shift work sleep disorders in type 2 diabetes mellitus .

3.1 The of Role of Sleep amount , insomnia and quality of sleep in type 2 DM

Normal sleep occurs when a person fall in sleep quietly and the duration of the sleep differs from children to older people[10]. The median duration of sleep in adult is 7 hours .

Insomnia is the most common sleep disorders . Insomnia is difficulty to fall sleep .The causes of insomnia are stress and poor sleep habits like using smartphone before sleeping. Insomnia is linked to increase risk of type 2 diabetes mellitus[11] .

According to Daniel,2005 there is relationship between sleep

deprivation to 4 hours/nights for 6 days leads to impaired in glucose tolerance[12].

Sleep restriction leads to increase cortisol level, which leads to insulin resistance . Also sleep deprivation cause elevation in sympathetic tone. Which decrease the pancreatic functions . All that leads to decrease glucose tolerance[13] .

There are 8 studies about sleep duration and control blood glucose . Hours of sleeping were assessed in these studies by using pittsbury quality index questioners or survey . They categorize people according to their sleep hours and they assessed their HbA1c levels. They found that short sleep mostly less than 6 hours per nights and long sleep mostly more than 9 hours per nights cause elevation in glycated hemoglobin (HbA1c) levels[14]. Glycated hemoglobin(HbA1c) when hemoglobin in red blood cells which carry o2 binding to glucose . It used to measure chronic glycaemia. The normal level of glycated hemoglobin less than 6% , if it is more than 6.5% it is indicating for diabetes mellitus[15] .

Also , there are 7 studies have 29.649 members to examine the effects of the duration of sleeping on HbA1c .They found that short hours sleep was linked to elevation in HbA1c level [weighted mean difference (WMD): 0.23; 95% CI: 0.10-0.36 , figure 1].Also , short hours sleep linked to elevation in fasting plasma glucose [WMD : 0.22 ; 95% CI: 0.08 -0.36 figure 2].¹⁴ Long sleep duration associated with increased HbA1c and with increased fasting blood glucose[14] .

Fifteen studies assed the relationship between blood glucose level and the quality of sleeping . All these studies found there are strong relationship between HbA1c and quality of the sleep[15] .

There are nine studies explore the shape of the relationship between the risk of type 2 diabetes mellitus and sleep duration .

There is a U- shaped relation between sleep duration and type 2 diabetes mellitus(figure 3)[9] .

3.2 The role of obstructive sleep apnea (OSA) in type 2 DM

Obstructive sleep apnea is considered by recurrent events of apnea and hypopnea[16] . There is collapse in upper air way passage[16] . Obstructive sleep apnea is linked with elevation in insulin resistance and insulin fasting[16] . There is cohort study have 1233 patients that was conducted to assess the relationship between obstructive sleep apnea and type 2 diabetes mellitus. The blood glucose level was high in patients have obstructive sleep apnea compared to control group . The value of blood glucose in the patients have obstructive sleep apnea was 99.4 mg /dl ,while the compared group was 95 mg /dl . The researchers followed patients for 2.7 years and they found that diabetes occurred in most of the patients who have 55 episode of sleep apnea .Also , it was found that there is changes in body mass index (BMI) in patients have obstructive sleep apnea . All these sleep disorders increase risk of type 2 diabetes mellitus[17].

Hypoxia (which is induced by apnea) has significant role in insulin resistance and changes in glucose level. Through release of proinflammatory cytokines like tumor necrosis factor – α and interleukin 6. These proinflammatory cytokines higher in patients have obstructive sleep apnea. Tumor necrosis factor- α linked to increase leptin which increase body fats and increase insulin resistance[18]. They are linked to type 2 diabetes mellitus. Several studies linked obstructive sleep apnea and increase activity of sympathetic, so there is increase in the breakdown of glycogen. Sleep apnea increase the risk of type 2 diabetes mellitus[19].

3.3 Slow wave sleep and type 2 diabetes mellitus

Sleep have 2 components : non rapid eye movement (NREM) and rapid eye movement (REM). non rapid eye movement also known as slow wave sleep. Sleep have 4 stages ,stage 3 and 4 are slow wave sleep. Slow wave sleep manifested by slow wave activity and non-rapid eye movement[6].

The beginning of slow wave sleep is matching with changes in hormones that affect glucose metabolism. Inhibition of slow wave sleep increase risk of type 2 diabetes mellitus, through decrease glucose tolerance and insulin sensitivity. Also, there is no time to increase insulin secretion. All that increase risk of diabetes mellitus[20].

3.4 Shift work disorders and type 2 diabetes mellitus

Shift work sleep disorders is disturbance in sleeping because you have night work. There are several studies link between shift work and type 2 diabetes mellitus. Shift work might induce obesity and changes in glucose metabolism. In addition, shift work cause changes in behavior like decrease physical activity which contribute to increase weight. Gaining weight through increase ghrelin level and reduction of leptin concentration. There is relationship between type 2 diabetes mellitus and circadian disturbance[21]. Healthy persons show alternation in insulin sensitivity and glucose regulation after 6 nights of 4 hours sleep deprivation[22].

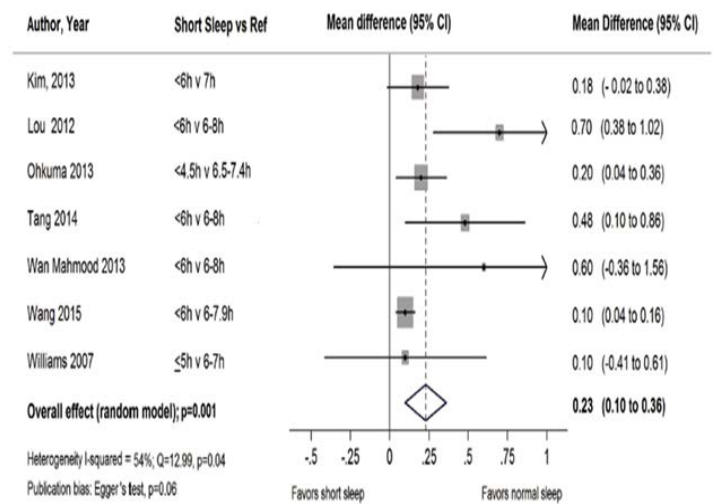


Figure 1 : Short sleep duration and the weighted mean difference in HbA1c levels among patients with type 2 diabetes mellitus (taken from Shaun ,2017)[14].

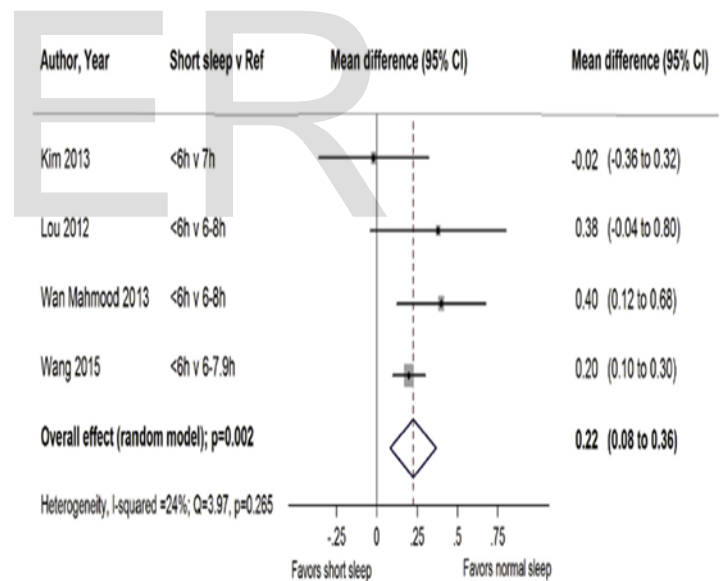


Figure 2: Short sleep duration and the weighted mean difference in fasting plasma glucose levels among patients with type 2 diabetes mellitus (taken from Shaun ,2017)[14].

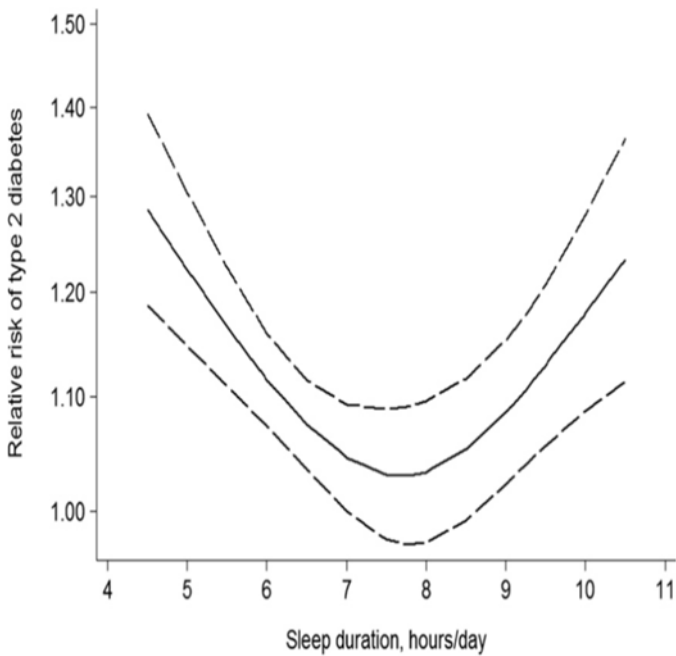


Figure 3: Sleep Duration and Risk of Type 2 Diabetes (taken from Zhilei , 2015)[9].

4 Conclusion

This study found that sleep disorders have a significant role in changing of blood glucose level and with type 2 diabetes mellitus .The increasing of stresses in social life and occupational pressure contribute to less sleeping hours and changes in the pattern of sleeping .Although it found a relationship between obstructive sleep apnea , decrease in slow wave sleep and increase risk of type 2 diabetes mellitus through changes in glucose metabolism and increase appetite .

In summary, a compelling evidence from several studies confirmed the relationship between disturbance in sleep physiology as a risk factor that increases the possibility of developing type 2 diabetes mellitus .

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6 Reverences

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