参考译文：

睡眠中的呼吸

Of all the physiological differences in human sleep compared with wakefulness that have been discovered in the last decade, changes in respiratory control are most dramatic. Not only are there differences in the level of the functioning of respiratory systems, there are even changes in how they function. Movements of the rib cage for breathing are reduced during sleep, making the contractions of the diaphragm more important. Yet because of the physics of lying down, the stomach applies weight against the diaphragm and makes it more difficult for the diaphragm to do its job. However, there are many other changes that affect respiration when asleep.

在过去的十年里人睡觉是和清醒时生理状态的不同已经被探索出来了，呼吸系统控制方面的变化尤其引人注目。不光是呼吸系统的功能层次方面有所不同，它们发挥作用的方式也出现了变化。胸腔所做的呼吸运动在睡觉时会减少，使得横膈膜的收缩变得更为重要。尽管由于躺下来的物理作用，胃部压迫横膈膜使得横膈膜难以工作。无论如何，睡眠时有很多其他的变化影响呼吸。

During wakefulness, breathing is controlled by two interacting systems. The first is an automatic, metabolic system whose control is centered in the brain stem. It subconsciously adjusts breathing rate and depth in order to regulate the levels of carbon dioxide (CO2) and oxygen (O2), and the acid-base ratio in the blood. The second system is the voluntary, behavioral system. Its control center is based in the forebrain, and it regulates breathing for use in speech, singing, sighing, and so on. It is capable of ignoring or overriding the automatic, metabolic system and produces an irregular pattern of breathing.

清醒的时候，呼吸受到两个互相影响的系统的控制。第一个是自动更新的系统主要负责控制脑干。它会潜意识的调整呼吸速率和深度来控制二氧化碳和氧气的浓度以及血液中的酸浓度。第二套系统是自发行为系统。它的控制中心在前脑，管理说话，叹气，唱歌等行为时的呼吸。它能忽略或者凌驾于第一套系统使得呼吸形式变得不规则。

During NREM (the phase of sleep in which there is no rapid eye movement) breathing becomes deeper and more regular, but there is also a decrease in the breathing rate, resulting in less air being exchanged overall. This occurs because during NREM sleep the automatic, metabolic system has exclusive control over breathing and the body uses less oxygen and produces less carbon dioxide. Also, during sleep the automatic metabolic system is less responsive to carbon dioxide levels and oxygen levels in the blood. Two things result from these changes in breathing control that occur during sleep. First, there may be a brief cessation or reduction of breathing when falling asleep as the sleeper waxes and wanes between sleep and wakefulness and their differing control mechanisms. Second, once sleep is fully obtained, there is an increase of carbon dioxide and a decrease of oxygen in the blood that persists during NREM.

在 NMER（睡觉时没有快速的眼部活动的阶段）这个阶段中呼吸会变得更深更有规律，但是呼吸频率会降低，导致整个空气交流减少。发生这个是因为在 NREM睡眠阶段中自动更新系统会独自控制呼吸以及身体，以便更少的利用氧气更少的产生二氧化碳。并且，自动更新系统对血液中二氧化碳和氧气的浓度并不敏感。在睡眠中呼吸控制的变化会导致两个结果。第一，睡着时呼吸会有短暂的停止或减少因为睡眠者在睡眠和清醒时及他们不同的控制系统呼吸会有增加或减少。第二，一旦得到了充足的睡眠，在 NREM 中就会使得血液中二氧化碳增加而氧气浓度减少。

But that is not all that changes. During all phases of sleep, several changes in the air passages have been observed. It takes twice as much effort to breathe during sleep because of greater resistance to airflow in the airways and changes in the efficiency of the muscles used for breathing. Some of the muscles that help keep the upper airway open when breathing tend to become more relaxed during sleep, especially during REM (the phase of sleep in which there is rapid eye movement). Without this muscular action, inhaling is like sucking air out of a balloon—the narrow passages tend to collapse. Also there is a regular cycle of change in resistance between the two sides of the nose. If something blocks the "good" side, such as congestion from allergies or a cold, then resistance increases dramatically. Coupled with these factors is the loss of the complex interactions among the muscles that can change the route of airflow from nose to mouth.

但这并不是全部的变化。在睡眠的所有阶段中，气道一些变化已经被观察到了。睡眠时它会用两倍的力度去呼吸因为呼吸道的阻力会比较强并且用来呼吸的肌肉的效率会有变化。在呼吸变得更轻松时有一些肌肉会帮助保持上部空气道的畅通，特别是在 REM 阶段（就是眼部运动非常剧烈的阶段）。没有这些肌肉运动，呼吸空气就像从气球里吸气一样，狭窄的通道会面临崩溃。尽管呼吸阻碍在鼻子两侧会有一个规则的循环。如果有时候堵塞了好的一边，比如过敏和感冒引起的堵塞，呼吸阻碍就会显著的提高。加上这些因素就是复杂的互相影响的肌肉系统对呼吸造成损失的原因，这些影响改变了空气从鼻子到嘴巴的流动路线。

Other respiratory regulating mechanisms apparently cease functioning during sleep. For example, during wakefulnessthere is an immediate, automatic, adaptive increase in breathing effort when inhaling is made more difficult (such as breathing through a restrictive face mask). This reflexive adjustment is totally absent during NREM sleep. Only after several inadequate breaths under such conditions, resulting in the considerable elevation of carbon dioxide and reduction of oxygen in the blood, is breathing effort adjusted. Finally, the coughing reflex in reaction to irritants in the airway produces not a cough during sleep but a cessation of breathing. If the irritation is severe enough, a sleeping person will arouse, clear the airway, then resume breathing and likely return to sleep.

其他的呼吸管理系统在睡觉时会明显的停止工作。比如说，在清醒时如果呼吸变得困难的话就会有一个立即自动适应性的呼吸增强（比如戴上面具呼吸时）。但在 NREM 状态时这种适应性的反应就会完全消失。只有在这种几次不足的呼吸之后，，才会使得血液中二氧化碳含量的显著提升以及氧气含量的降低，这种呼吸调整才会起作用。最后，咳嗽对气道的刺激不会在睡眠中而是造成呼吸的暂停。如果刺激足够严厉，一个睡着的人会惊醒，清理气道，然后继续呼吸并睡觉。

Additional breathing changes occur during REM sleep that are even more dramatic than the changes that occur during NREM. The amount of air exchanged is even lower in REM than NREM because, although breathing is more rapid in REM,it is also more irregular, with brief episodes of shallow breathing or absence of breathing. In addition, breathing during REM depends much more on the action of the diaphragm and much less on rib cage action.

发生在 REM 时期的多余的呼吸变化要比发生在 NREM 时期的呼吸变化要显著。REM 的空气交换量要比 NREM 低，尽管 REM 中呼吸更加急促，但也更加没有规律，包括一些间断的呼吸暂停。另外，REM 时期的呼吸更多取决于横膈膜而不是胸腔的作用。