

Sleep disturbances and memory impairment among pregnant women consuming khat: An under-recognized problem

Md. Dilshad Manzar¹, Mohammed Salahuddin², Peter Sony¹, Tarekegn Tesfaye Maru², Seithikurippu R. Pandi-Perumal^{3,4}, Adam Moscovitch⁵, Ahmed S. Bahammam^{3,4}

¹Department of Biomedical Sciences, College of Health Sciences, Mizan-Tepi University, (Mizan Campus),

²Department of Pharmacy, College of Health Sciences, Mizan-Tepi University, (Mizan Campus), Mizan Teferi, Ethiopia, ³University Sleep Disorders Center, College of Medicine, King Saud University,

⁴National Plan for Science and Technology, College of Medicine, King Saud University, Riyadh, Saudi Arabia, ⁵Sleep and Fatigue Institute, the University of Calgary, Calgary, Canada

Address for correspondence:

Prof. Ahmed S. Bahammam, University Sleep Disorders Center, King Saud University, Riyadh, Saudi Arabia. E-mail: ashammam2@gmail.com

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Abstract:

Khat (*Catha edulis*) is a evergreen flowering shrub that is cultivated at high altitudes, especially in East Africa and the southwest of the Arabian Peninsula. The plant contains alkaloids, of which cathinone and cathine have structural similarity and pharmacological action similar to amphetamines. The leaves are, therefore, consumed in some regions as a psychoactive stimulant due to cultural beliefs and misperceptions on the health benefits of khat consumption. This resulted in a growing prevalence of khat consumption among pregnant women. The myriad of physiological changes associated with pregnancy impairs sleep and memory. Moreover, khat has also been shown to have adverse effects on memory and sleep. Therefore, its use during pregnancy may further aggravate those impairments. The purpose of this mini-review is to summarize the changes in sleep and memory during pregnancy and the evidence supporting a relationship between khat consumption and neurocognitive deficits and sleep dysfunctions. The misperceptions of beneficial effects of khat, the high prevalence of consumption among pregnant women, and the possibility of under-reporting of khat abuse do necessitate the development of alternative methodologies to identify cases of unreported khat abuse in pregnant women. It is proposed that screening for sleep problems and memory deficits may help identify under-reported cases of khat abuse in pregnant women.

Keywords:

Catha edulis, chat, neurocognitive, memory, pregnancy, sleep, khat

Khat (*Catha edulis*) is an evergreen flowering shrub that grows at high altitudes. It is cultivated especially in East Africa and the southwest of the Arabian Peninsula. The young tender leaves are used as a psychoactive stimulant. The major active compounds are alkaloids, of which cathinone and cathine are the most active ones. These are similar in structure and pharmacological activity to amphetamines and stimulate the central nervous system.^[1] The global consumption is continually increasing, with new parts of the world reporting and documenting

this social habit. This is mainly because migrants from the khat-growing regions are settling in Europe, America, and Australia.^[2,3] Khat use is greatly prevalent in Afro-Asian countries.^[3-6] The social burden can be grossly estimated from the prevalence of khat use being as high as 90% in some regions. Khat use by women is increasing.^[3-5] Unfortunately, khat use is common in women even during pregnancy. High prevalence of khat consumption (as high as 60% in general women and 40.7% in pregnant women) has been reported.^[3]

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The cultural beliefs that khat consumption has health benefits such as relief of a headache, weight loss and assistance in birth, and delivery may account for the risky practice.^[7] Under-reporting of khat consumption (due to social desirability bias) makes it difficult for the gynecological and antenatal health-care systems to provide a timely intervention.^[8] It is therefore very important to identify potential clinical markers of complications related to khat consumption in pregnant women. Such markers may help identify cases of khat abuse in pregnant women.

Both memory deficits and sleep problems are associated with pregnancy.^[9-11] This mini-review summarizes the evidence supporting a relationship between khat consumption and memory deficits and sleep problems in pregnancy. Figure 1 demonstrates a schematic representation of the relationship between khat consumption, sleep problems, pregnancy, and memory deficit.

Sleep and Memory

One of the important functional roles of sleep is facilitation and consolidation of learning and memory.^[12,13] The effects of disturbed sleep on memory are summarized in Table 1. Chronic sleep deprivation has a detrimental effect on cognitive functioning during pregnancy.^[16,18] Moreover, partial sleep deprivation is associated with reduced cognitive performance in pregnant women.^[17] Insufficient sleep has a negative effect on cognitive performance including problem-solving, language, forward planning, and attention.^[14] Sleep deficits the night before decrease memory and concentration tasks.^[15] The performance of memory and concentration tasks in postpartum women is significantly predicted by the amount of sleep they had the preceding night.^[15] Further, the causal implication of sleep disturbances and deprivation on memory is supported by the finding that declarative memory significantly improved after sleep in healthy adolescents.^[19]

Sleep in Pregnancy

The multifaceted physiological changes during pregnancy manifest as irregularities in sleep [Table 2].^[9,20]

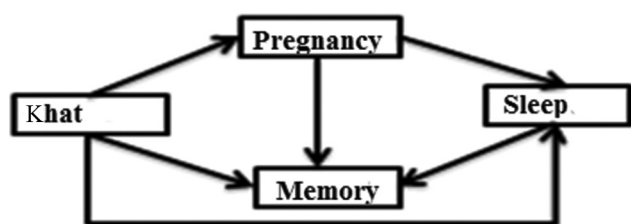


Figure 1: Schematic representation of the relationship between pregnancy, khat consumption, sleep problems, and memory deficit

The effects of pregnancy on sleep are summarized in Table 2. Insomnia,^[20,23] poor sleep efficiency,^[9] and short sleep duration^[9] are usually prevalent in pregnant women. Poor sleep usually improves after delivery and subsequently improves steadily.^[10,21] Sleep irregularities are dynamic and gradually change during pregnancy.^[9,15,23] Increased daytime sleepiness,^[23] increased nocturnal insomnia,^[23] increased total sleep time (regular naps), and decreased stage N3 sleep are usually seen in the first trimester.^[16,23] The second trimester is characterized by increased sleep latency,^[9] increased awakenings,^[9,23] fewer hours of night sleep,^[9] decreased sleep efficiency, decreased stages N3, and rapid eye movement (REM) sleep.^[23] Decreased total sleep time, increased insomnia, increased daytime sleepiness, increased stage N1 sleep, increased waking after sleep onset, decreased stage N3 sleep, and decreased REM sleep are seen in the third trimester.^[23] Sleep problems

Table 1: Effects of disturbed sleep on memory

Author	Effects
Miller <i>et al.</i> ^[14]	Impaired memory, problem-solving, language, forward planning, and attention
Swain <i>et al.</i> ^[15]	Decreased memory and concentration tasks
Chang <i>et al.</i> ^[16]	Impaired cognitive functioning
Kempler <i>et al.</i> ^[17]	Decreased cognitive performance
Gais <i>et al.</i> ^[18]	Impaired memory

Table 2: The effects of pregnancy on sleep

Author	Effects
Insana <i>et al.</i> ^[9] , Swain <i>et al.</i> ^[15]	Increased sleep latency, increased awakenings, fewer hours of night sleep and decreased sleep efficiency begins in the second trimester and extends through at least the first 2-3 months after delivery
Montgomery-Downs <i>et al.</i> ^[21]	Sleep quality diminishes progressively throughout pregnancy
Palagini <i>et al.</i> ^[20]	Poor sleep quality, sleep loss/short sleep duration, poor sleep efficiency, and insomnia
Matthey and Ross-Hamid ^[22]	Sleep disturbance
Chang <i>et al.</i> ^[16]	Increased total sleep time and daytime sleepiness during the first trimester, decreased total sleep time in the third trimester
Hashmi <i>et al.</i> ^[23]	Increased daytime sleepiness, increased nocturnal insomnia, Increased total sleep time (regular naps), decreased NREM 3/4 in the first trimester Increased awakening, decreased NREM 3/4 and REM in the second trimester Decreased total sleep time, increased insomnia, increased daytime sleepiness, increased NREM 1, increased waking after sleep onset, decreased NREM 3/4, decreased REM

NREM = Non-rapid eye movement, REM = Rapid eye movement

during pregnancy have been found to adversely affect maternal and fetal outcomes (i.e., cesarean section rates; longer, preterm, and uncomfortable labor; and increased perception of pain).^[16,24]

The effects of pregnancy and its associated medical conditions on memory are summarized in Table 3. Cognition is impaired during pregnancy and this manifests as poor memory performance during the three trimesters.^[27] Pregnancy affects long-term memory (both implicit and explicit) and short-term/working memory. There is a substantial evidence indicating that pregnancy has a negative influence on declarative memory. The results are more conclusive regarding the recall memory but not recognition.^[11] The physiology behind this impairment is not clear with several proposed mechanisms.^[10,11] Crawley *et al.* reported perceived impairments in verbal memory in pregnant women.^[26] Sleep disturbance (e.g., fragmentation and deprivation) have been linked to lower scores on tasks of immediate memory, complex mental functions (e.g., problem-solving), and overall daytime function during the immediate postpartum period.^[9,25,28]

Table 3: The effects of pregnancy on memory

Author	Effects
Insana <i>et al.</i> , ^[9] Insana <i>et al.</i> ^[25]	Lower scores on tasks of immediate memory, complex mental functions (e.g., problem-solving) and overall daytime function during the immediate postpartum period
Crawley <i>et al.</i> ^[26]	Impaired verbal memory
Mickes <i>et al.</i> ^[11]	Impaired declarative memory
de Groot <i>et al.</i> ^[27]	Poor memory performance across all three trimesters

Table 4: The effects of khat consumption on pregnancy and birth outcome

Author	Effects
Muema ^[29]	Low/decreased High/increased
Gashaw and Getachew ^[30]	Impaired Low/decreased High/increased
Favrod-Coune and Broers ^[31]	Increased risk of dysmature infants
Khawaja <i>et al.</i> ^[6]	Low/decreased Others
Getahun <i>et al.</i> ^[32]	Increased diastolic blood pressure
Toennes <i>et al.</i> ^[33]	Increased heart rate
Hassan <i>et al.</i> , ^[34] Wabe ^[35]	Low birth weight
Kuczkowski ^[36]	Chest pain, sinus tachycardia, and hypertension
Basker ^[37]	Decreased placental blood flow and fetal growth
Al-Motarreb <i>et al.</i> , ^[38] Matthey and Ross-Hamid ^[22]	Anorexia, appetite changes, fatigue

ALP = Alkaline phosphatase, ALT = Alanine aminotransferase, AST = Aspartate aminotransferase

Khat and Pregnancy

The khat has been found to have detrimental effects on both pregnant women and babies [Table 4]. It has been implicated in impaired liver and kidney function, hormonal profiles and fetal outcomes,^[29] teratogenicity,^[6] anorexia, appetite changes, and fatigue.^[22,38] The khat use during pregnancy is associated with the increase in parameters such as heart rate,^[33] diastolic blood pressure,^[32] alkaline phosphatase, aspartate aminotransferase, alanine aminotransferase, creatinine, blood urea, estrogen,^[29] postimplantation losses,^[30] and increased risk of dysmature infants.^[31]

Further, khat consumption and cathinone level in pregnancy have been related to low birth weight,^[6,29,34,35] decreased uteri-placental blood flow,^[6,29] decreased maternal myometrial blood flow, decreased maternal milk production, reduced fetal growth and development,^[6,30,37] low plasma albumin and sodium, low maternal weight,^[29] and decreased lipid.^[6] Chest pain, sinus tachycardia, and hypertension were reported in a pregnant woman after khat chewing in a case report.^[36] Therefore, it is very important to closely monitor pregnant women with history of khat consumption.

Khat and Sleep

Khat has been found to affect sleep and to be associated with sleep problems [Table 5].^[39-41] The prevalence of sleep problems was very high in khat users (65%), with 31% reporting moderate to severe level of disturbances.^[43] Sleep disturbance,^[40,42,43] insomnia,^[38,39,41] and nightmares^[38] have been commonly reported in khat

users. After a khat session, the user usually experiences depressed mood, irritability, anorexia, and difficulty to sleep.^[38] Lethargy and a sleepy state follow the next morning. In chronic khat users, sudden discontinuation results in withdrawal symptoms during the 1st day, such as sleeping disturbances, depression, and intense cravings.^[40] This diabolic situation of depression with continued use as well as depression on discontinuation of khat can be very challenging for the antenatal care system.^[38,40] Since depression^[44] and sleep deprivation^[16] are common in pregnant women, khat consumption may further aggravate both symptoms. Sleep gradually improves on discontinuation of khat.^[38,45] This further establishes the contributory relationship between sleep problems and khat consumption.

Khat and Memory

Multiple areas of neurocognitive deficit have been identified in chronic users of psychostimulants, such as amphetamines and methamphetamines.^[1,46,47] Effects of khat consumption on memory are summarized in Table 6. Khat has been shown to result in long-term memory deficits (both implicit and explicit) in different populations.^[48,49] Khat users had been found to have attentional impairment,^[40] impaired inhibitory control,^[49] impairments in cognitive flexibility and monitoring of information in working memory,^[48] and impaired spatial learning and memory.^[51] Moreover, khat abuse may impair working memory, perceptual-visual memory, and decision speed cognitive functions.^[1,49,52] Concurrent use of khat and tobacco impairs verbal learning, working memory, and delayed recall deficits.^[3,4] Khat abuse

is pregnant women may adversely affect neonate's cognitive health.^[29] Mild problems in cognition, attention, and neuromotor functioning are associated with the low birth weight in neonates.^[29]

Conclusions

Complex physiological changes occur during pregnancy and result in impairment of sleep and memory. The adverse effects of khat on memory and sleep may further aggravate those impairments. Impaired cognitive function may put the pregnant women and her fetus at risk.^[52] Impairment of explicit memory may interfere with adherence to prescribed medicine. This may expose pregnant women to the risk of underdose or overdose. Moreover, khat-chewing pregnant women with impaired implicit memory may have problems in skills, tasks, and planning-related activities.^[53] In such a situation, the daily routine of a pregnant woman will be chaos. The misperceptions of beneficial effects of khat (e.g., relief of a headache, weight loss and assistance in birth, and delivery),^[7] the high prevalence of consumption among pregnant women,^[6] and the possibility of under-reporting of khat abuse^[8] do necessitate the development of alternative methodologies to identify cases of unreported khat abuse in pregnant women. It is proposed that screening sleep and memory in pregnant women may provide an additional tool to identify unreported khat abuse. This will help provide timely intervention and decrease the potential risk of complications in pregnant women with a history of khat consumption.

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Conflicts of interest

There are no conflicts of interest.

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Table 5: The effects of khat consumption on sleep

Author	Effectuated/associated factor
Al-Habori ^[40]	Sleeping problems, depressive states
Hassan <i>et al.</i> , ^[41] Al-Ghamdi ^[39]	Insomnia
Al-Motarreb <i>et al.</i> ^[38]	Difficulty to sleep, sleep nightmares
Al-Motarreb <i>et al.</i> ^[38]	Sleep improves on discontinuation of khat
Belew <i>et al.</i> , ^[42] Patel <i>et al.</i> ^[43]	Sleep disturbances

Table 6: The effects of khat consumption on memory

Author	Effectuated/associated factor
Colzato <i>et al.</i> ^[48]	Impaired cognitive flexibility and monitoring of information in working memory
Colzato <i>et al.</i> ^[49]	Decreased inhibitory control
Colzato <i>et al.</i> , ^[48]	Long-term memory (both implicit and explicit) deficits and short-term/working memory deficits in different demographics
Khatab and Amer ^[50]	Impaired perceptual-visual memory and decision speed cognitive functions
Kimani <i>et al.</i> ^[46]	Memory deficits
Kimani and Nyongesa ^[51]	Impaired spatial learning and memory
Hoffman and Al'Absi, ^[3]	Impaired verbal learning, working memory, and delayed recall deficits
Nakajima <i>et al.</i> ^[4]	

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