Introduction

Khat (Catha edulis) is an evergreen plant and its fresh green leaves and buds are chewed for several hours a day for its psychostimulant response. This study aimed to review the effects of khat chewing on the body. PubMed was searched for literature on the different aspects of khat chewing to summarize its effects on different body systems. The major effects of khat chewing are those on the cardiovascular system including increased blood pressure, increased heart rate, and increased risk of myocardial infarction. It causes insomnia, stress, depression, hallucination, and increased risk of brain stroke. It causes dental caries, bad oral hygiene, periodontitis, increased oral mucosal ulcers, and increased gingival bleeding and recession. Khat chewing causes loss of appetite, gastritis, constipation, and hemorrhoids, and increased risk of hepatotoxicity and liver cirrhosis. Ultimately, it causes weak micturition, decreased sperm motility and count, and low birth-weight offspring in khat chewing mothers. The published articles about khat chewing in journals indexed in the PubMed was reviewed. Inclusion criteria involved each article available with English language and have a reported new effect of khat chewing.

Keywords: Effects of khat chewing on the cardiovascular system, effects of khat chewing on the gastrointestinal tract, effects of khat chewing on the genitourinary system, effects of khat chewing on the nervous system
the habit of khat chewing for its stimulant and euphoric effect without awareness about its adverse health consequences. The knowledge gap contributes to the increase in the prevalence of khat chewing with increase of its farm and demand.[1,2,3]

Khat chewing cause a wide range of effects that include alertness, anxiety, stress, and depression.[4] It causes negative physical consequences including oral lesions, gastric cancers, duodenal ulcers, hepatotoxicity, hypertension (HTN), cardiovascular (CV) problems, and stroke. Prolonged excessive use of khat induces psychological dependence, depression, and even psychotic disorders.[7] The World Health Organization reported that khat has amphetamine-like stimulant, which causes euphoria and loss of appetite and it can also cause CV, gastrointestinal disorders and dental decay with long-term use.[8]

Khat chewing is a widespread social habit in the horn of Africa and south peninsula with bad personal and socioeconomic effects such as loss of working hours of the users and deprivation, family instability, and household poverty. Family doctors must do their role in educating the community about the risks of this habit. As this habit has been neglected in scientific researches, we introduce this literature review to provide an overview of the effects of khat chewing on the cardiovascular system, nervous system, digestive, and genitourinary systems.

Materials and Methods

A research of PubMed was performed up to August 2020 using the following words in different combinations: “Effects of khat chewing on the cardiovascular system,” “Effects of khat chewing on the nervous system,” “Effects of khat chewing on the gastrointestinal tract,” and “Effects of khat chewing on the genitourinary system.” There were no restrictions regarding publication date. The authors discussed and decided the selected articles. Papers were included or excluded based on the title and abstract. Inclusion criteria involved each article available in PubMed in English language and have a new effect of khat chewing. Exclusion criteria included case reports, articles with repeated information, articles with pre-clinical studies, and articles do not include in the PubMed. However, review articles were used in the introduction section. The majority of articles were observational studies.

Discussion

Khat effect on the cardiovascular system

In the literature [Table 1], we found that khat chewing causes hypertension.[9,12] Khat chewing increases heart rate.[11,13] This was explained by Wabe et al.[17] as a result of the vasoconstrictor activity of cathinone, which may be sustained in regular khat chewers.[11,12] In addition, Geta et al.[9] and Ali et al.[14] reported that cathinone has positive inotropic and chronotropic actions on isolated atria. Khat chewing increases risk of acute myocardial infarction (AMI).[13,15] This was explained by the coronary vasospasm effect of khat and thrombus formation due to catecholamine-mediated platelet aggregation.[14] The coronary vasospasm was explained by Ali et al.[14] and Al-Motarreb et al.[16] as amphetamine-like action of cathinone increases irritability and nervous tension after khat session that, in addition to increased heart rate it increases oxygen demand of the heart muscle and induces catecholamine-mediated platelet aggregation, which causes coronary vasospasm.

Khat effect on the nervous system

In the literature [Table 2], we found that khat chewing causes insomnia and sleep disturbances.[17,18] This may be explained by the irritability and the nervous tension effect of cathinone after khat session.[9,14,16] Khat chewing increases hallucination and stress.[19,20] This was explained by Wabe et al.[17] as khat chewing causes auditory hallucination and anxiety as same as amphetamine psychosis. El-Setouhy et al.[21] reported that khat chewing causes psychological dependence effect. Dependence effect was explained to be caused by the effect of cathinolamine in the synaptic clefts of the nerve cells.[22] Furthermore, khat chewing increases incidence of brain stroke as reported by Kulkarni et al.[23] Ali et al.[14] explains this increase of cerebral stroke in khat chewers by increased cerebral vasospasm. Other study reported that longtime khat chewing causes increase intima-media thickness and plaque formation in the carotid artery and this may add another explanation of increased cerebral stroke in khat chewers.[24]

![Table 1: Khat effects on the cardiovascular system](image)

| Author          | Year | Effect                                |
|-----------------|------|---------------------------------------|
| Geta et al.[9]  | 2019 | (↑) blood pressure, both systolic and diastolic (SBP and DBP) |
| Sallam et al.[9] | 2017 | (↑) blood pressure, both systolic and diastolic (SBP and DBP) |
| El-Menyar et al.[11] | 2015 | (↑) catecholamine release (↑) heart rate (↑) blood pressure |
| Getahun et al.[9]  | 2010 | (↑) mean blood pressure |
| Ali et al.[14]  | 2011 | (↑) risk of STEMI and recurrent MI (↑) heart rate (↑) cardiogenic shock (↑) ventricular arrhythmia (↑) cardiogenic shock (↑) risk of death |
| Al-Motarreb et al.[16] | 2013 | (↑) acute myocardial infarction (AMI) |

SBP: systolic blood pressure, DBP: diastolic blood pressure, ↑: increase, ↓: decrease, MI: myocardial infarction, AMI: acute MI, STEMI: ST-elevation MI.

![Table 2: Khat effects on the nervous system](image)

| Author          | Year | Effect                                |
|-----------------|------|---------------------------------------|
| Abacheew et al.[17] | 2019 | (↑) insomnia (↑) depression |
| Teni et al.[11] | 2015 | (↑) sleep disturbance |
| Ongeri et al.[9] | 2019 | (↑) hallucination |
| Al-Abis et al.[16] | 2013 | (↑) stress |
| El-Setouhy et al.[21] | 2016 | (↑) psychological dependence effect |
| Kulkarni et al.[23] | 2012 | (↑) brain stroke |

↑: increase, ↓: decrease
Khat effect on the oral cavity

In the literature [Table 3], we found that khat chewing causes increased dental caries.\(^{[17,23,24]}\) It causes increased incidence of oral mucosal ulcers, gingival bleeding, and recession.\(^{[27,28]}\) It also causes decreased rate of saliva excretion and causes low salivary \( \text{PH} \) value.\(^{[29]}\) It causes increase incidence of periodontitis and oral cancer.\(^{[30]}\) Explanation was reported by Tarboush \textit{et al}.\(^{[31]}\) by the pro-oxidant effect of khat chewing that leads to dental caries, periodontitis, and increased oral cancer. In another study, Math \textit{et al}.\(^{[32]}\) introduced evidence that connected between khat chewing and oral mucosal genetic damage and cancer. Schmidt-Westhausen \textit{et al}.\(^{[33]}\) reported that khat chewing induces premalignant oral lesions those are dependent on site, dose, and time of khat chewing. Likewise, Lukanda \textit{et al}.\(^{[34]}\) reported acanthosis, hyperkeratosis, and fibrosis as histological features of oral lesions induced by chronic khat chewing.

Khat effect on the digestive system

In the literature [Table 4], we found that khat chewing causes gastritis.\(^{[17,18]}\) Gastritis was related to the astringent tannis in khat that irritates the gastric mucosa causing inflammation and gastritis.\(^{[35]}\) It causes constipation.\(^{[36,37]}\) Nigussie \textit{et al}.\(^{[38]}\) explained this as cathinone-stimulated release of noradrenaline from storage vesicles that stimulate CNS and causes sympathomimetic effect, which decrease gastrointestinal and colon motility and increase sphincter tone and as a consequence increases water absorption, which leads to formation of hard stool and consumption. Khat chewing causes hemorrhoids and the pathogenesis of hemorrhoids was explained by Nigussie as prolonged sitting during khat chewing sessions and constipation causes straining during defection, which induces hemorrhoid formation.\(^{[39]}\) Mahamoud \textit{et al}.\(^{[40]}\) reported that khat chewing increases risk of hepatotoxicity and liver cirrhosis, which may be related to the pesticides and herbicides that are used in khat farms. Furthermore, Abid \textit{et al}.\(^{[41]}\) reported that khat chewing triggers generation of intracellular reactive oxygen species that induces activation of c-Jun NH2-terminal kinase, which results in increased cell apoptosis and decreased cell viability. Khat chewing caused decreased appetite.\(^{[18]}\) This explains the decrease of weight and body mass index, which is common in khat chewers.\(^{[36]}\)

Khat effect on the genitourinary system

In the literature [Table 5], we found that khat chewing causes weak stream of micturition.\(^{[57]}\) Urine retention was explained by the autonomic effect of cathinone on the peripheral nervous system.\(^{[48]}\) As mentioned previously, other explanation was introduced by Nigussie \textit{et al}.\(^{[33]}\) who reported that the sympathomimetic effect of cathinone increases sphincter tone. Demelash \textit{et al}.\(^{[49]}\) reported that khat chewing causes low birth-weight of the newborns of khat-chewer mothers. This was explained by Wabe as khat chewing reduces placental blood flow and produces growth retardation.\(^{[40]}\) Nyachicho \textit{et al}.\(^{[40]}\) reported that khat chewing causes decreased sperm count, motility, and plasma testosterone. This was explained by the toxic effect of cathinone which, in addition, causes increase in the number of sperms with morphological changes.\(^{[49]}\)

### Table 3: Khat effects on the oral cavity

| Author               | Year | Effect                  |
|----------------------|------|-------------------------|
| Alebachew \textit{et al}.\(^{[37]}\) | 2019 | ↑ dental caries          |
| Al-Alimi \textit{et al}.\(^{[27]}\) | 2018 | ↑ dental caries          |
| Tarboush \textit{et al}.\(^{[29]}\) | 2019 | ↑ oral cancer            |
|                      |      | ↑ periodontitis          |
|                      |      | ↑ dental caries          |
| Al-Kholané\(^{[3]1}\) | 2010 | ↓ oral hygiene           |
|                      |      | ↑ incidence of gingival bleeding |
|                      |      | ↑ incidence of oral mucosal ulcers |
|                      |      | ↑ gingival recession     |
| Al-Maweri \textit{et al}.\(^{[31]}\) | 2017 | ↑ gingival recession     |
| Badulla \textit{et al}.\(^{[29]}\) | 2019 | ↓ baseline salivary \( \text{PH} \) |
|                      |      | ↓ flow rate of saliva    |
| Math \textit{et al}.\(^{[34]}\) | 2016 | ↑ oral cancer            |

↑: increase, ↓: decrease

### Table 4: Khat effects on the digestive system

| Author               | Year | Effect                  |
|----------------------|------|-------------------------|
| Alebachew \textit{et al}.\(^{[37]}\) | 2019 | ↑ gastritis             |
| Teni \textit{et al}.\(^{[38]}\) | 2015 | ↑ loss of appetite       |
| Math \textit{et al}.\(^{[34]}\) | 2016 | ↑ esophagel and gastric cancer |
| Nigussie \textit{et al}.\(^{[33]}\) | 2013 | ↑ dental problems       |
|                      |      | ↑ gastritis             |
|                      |      | ↑ constipation           |
|                      |      | ↑ hemorrhoids           |
| Mahamoud \textit{et al}.\(^{[40]}\) | 2016 | ↑ hepatotoxicity         |
|                      |      | ↑ liver cirrhosis        |

↑: increase, ↓: decrease

### Table 5: Khat effects on the genitourinary system

| Author               | Year | Effect                  |
|----------------------|------|-------------------------|
| Hassan \textit{et al}.\(^{[37]}\) | 2002 | ↓ stream of micturition  |
|                      |      | ↑ urethral discharge post-micturition |
| Demelash \textit{et al}.\(^{[49]}\) | 2015 | ↑ low birth-weight       |
| Nyachicho \textit{et al}.\(^{[40]}\) | 2013 | ↑ sperm motility        |
|                      |      | ↑ sperm count            |
|                      |      | ↑ testosterone level     |
|                      |      | ↑ prolactin level        |

↑: increase, ↓: decrease

### Conclusions

Several studies across the world reported that khat chewing has multiple harmful effects on the human body. It causes hypertension, increased heart rate and increased risk of acute myocardial infarction. Khat chewing causes insomnia and sleep disturbances, dependence, and increased risk of cerebral stroke. Oral problems including dental caries, oral mucosal ulcers, gingival bleeding and recession, and increased risk of oral cancer were reported in khat chewers. Khat chewing causes gastritis, anorexia, constipation, increased risk of hepatotoxicity, liver cirrhosis, and esophageal and gastric cancers. Weak stream of micturition, decreased sperm count and motility, and low
Khat chewing is a risk factor for acute cardiovascular, adrenocortical, and psychological responses to stress in the horn of Africa and the southern Arabian Peninsula, it has been neglected by scientific researchers as a medical problem.

**Key messages**

1. Khat chewing has unfavorable personal outcomes and family deprivation and unfairness.
2. Khat chewing has serious medical problems on the cardiovascular systems, starting from increased heart beats to increased risk of myocardial infarction.
3. Khat chewing has many behavioral and nervous bad effects, starting from sleep disturbance to increased risk of brain stroke.
4. Khat chewing has a lot of gastrointestinal tract health problems, starting from dental caries to increased risk of hepatotoxicity and gastrointestinal tract cancers.

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**Conflicts of interest**

There are no conflicts of interest.

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