



## RESEARCH ARTICLE

**A STUDY OF ASSOCIATION AMONG BODY COMPOSITION AND KHAT CHEWING AMONG THE EMPLOYEES OF UNIVERSITY OF SCIENCE AND TECHNOLOGY, SANA'A, YEMEN****Nabil Q. M. Al-Hajj<sup>1,\*</sup>, Doaa Mutahar<sup>2</sup>, Najeeb Y. Alsurmi<sup>3</sup>, Sallah Al-Hashedi<sup>4</sup>, Saeed Badahdah<sup>5</sup>, Hafiz Rizwan Sharif<sup>6</sup>**<sup>1</sup> Dept. of Therapeutic Nutrition and Dietetics, Faculty of Medicine and Health Science, University of Science and Technology, Sana'a, Yemen.<sup>2</sup> Dept. of Community and Family Medicine, Faculty of Medicine and Health Science, University of Science and Technology, Sana'a, Yemen.<sup>3</sup> Genetic Resources Center, College of Agriculture, Sana'a University, Yemen.<sup>4</sup> Central Labs, King Faisal University, Al-Ahsa, Saudi Arabia.<sup>5</sup> Dept. of Food Sciences, College of Agricultural Al-Nasser, University of Aden, Yemen.<sup>6</sup> Dept. of Food Science and Technology, Faculty of Science and Technology, University of Central Punjab, Lahore, Pakistan.**\*Corresponding author: Nabil Al-Hajj; E-mail: n.alhajj@ust.edu.ye, alwossabii@gmail.com****Received: 26 February 2024 / Accepted: 25 May 2024 / Published online: 30 June 2024****Abstract**

Catha edulis (khat) is a plant grown commonly in the Republic of Yemen. The leaves of small khat are chewed by the people for its stimulant action. Association between body composition, khat chewing is little known. We recruited 300 individuals 19-70 years of age from University of Science and Technology, Sana'a, Yemen. Demographic, body composition and physical activity data were collected using structured questionnaires and anthropometric measurements devices. Muscle mass (kg), body fat (kg), visceral fat (kg), waist circumference (cm) and body Mass index (kg/m<sup>2</sup>) were estimated. Participants in habit of khat chewing were 170 (56.7%) of Chewer and 130 (43.3%) of non-chewer. Participants' mean  $\pm$  SD of age was 38.7 $\pm$ 9 years, 217 (72.3%) and 83 (27.7%) were males and females, respectively. Including 40 (13.3%) smokers and 260 (86.7%) non-smokers. Whereas 151 (88.8%) of the men and 19 (11.2%) of the women take khat, including 39 (22.9%) academics and 131 (77.1%) non-academics. In addition, 46 (27.1%) have low activity and 105 (61.8%) had moderate activity and 19 (11.2%) had high activity. Participants in daily khat chewing were 77 (45.3%) while 14 (8.2%), 43 (25.3%), 36 (21.2%) were 4-6 times/week, 2-3 times/week and Once/week, respectively. Participants spent an average of 4.5 $\pm$ 2 hours per day in khat chewing sessions, with 52.9% spending 1-4 hours, 43.5% spending 5-8 hours, and 3.5% spending more than 8 hours. The majority of khat chewers reported spending around 2000 Yemeni Riyals (Y.R.) per day on khat. In terms of the impact on meal schedules, 38.8%. Khat chewers had higher muscle mass (33 $\pm$ 6), lower body fat percentages (27.8 $\pm$ 9), higher levels of visceral fat (9.3 $\pm$ 4), larger waist circumferences (88.4 $\pm$ 10) and slightly higher BMI values (25.9 $\pm$ 4) compared with non-chewers were muscle mass (29.9 $\pm$ 7), body fat percentages (31 $\pm$ 12 levels of visceral fat (7.8 $\pm$ 4), waist circumferences (82.6 $\pm$ 11) and BMI values (24.9 $\pm$ 4). In addition to, males khat chewers had higher muscle mass, higher visceral fat levels and higher waist circumferences values in compared with females where were muscle mass, visceral fat levels and waist circumferences low. There is no significant association between khat chewers' status and excess body fat.

**Keywords:** Khat chewing, Muscle mass, Body fat, Visceral fat, Waist circumference, Body mass index.**1. Introduction**

Yemen is located on the southwestern edge of the Arabian Peninsula, with a total area of 527,970 square kilometers. It is bordered by the Kingdom of Saudi

Arabia to the north, the Sultanate of Oman to the east, the Arabian Sea and the Gulf of Aden to the south, and the Red Sea to the west [1].



Fig 1. Map of Yemen (source: www.google.com)

Khat (*Catha edulis*, *Celastraceae*) is an evergreen shrub or tree (1–25 m tall), the fresh leaves of which contain cathinone, cathine, and norephedrine, which are sympathomimetic compounds. The plant is native to the Horn of Africa and the Republic of Yemen and has been widely cultivated and consumed for motivational, social and psychological reasons has been practiced for many centuries in Yemen [2]. In Yemen there are about 40 kinds of Qat grown at different altitudes in Sana'a, Taiz, and others [3]. The continuous and increasing production of Qat represents one of the biggest challenges facing Yemen in the modern era. While Qat contributes greatly to the national product (which is estimated at more than 9%), it causes nutritional, health, social and economic problems [4].

Chewing Qat consumes a large percentage of the income of the right-wing family, especially Khat chewing is prevalent among Yemeni people, with a higher prevalence in males than in females [5]. Khat contains numerous alkaloids and also over 40 different chemical compounds [6]. About 90% of the active chemicals present in khat leaves are released during chewing. The peripheral and central stimulant alkaloid cathinone (S-( $\alpha$ -aminopropiophenone) is considered to be the primary psychoactive compound in the khat leaves [6]. Khat has various physiologic and metabolic effects associated with a decrease in appetite and body weight, possibly mediated via increasing the release of leptin from the stomach [4].

Khat chewing and its impact on elevated plasma leptin, esterified fatty acid production and resulting lipodystrophy, which leads to further problems on the cardiovascular system, urinary system, gastrointestinal tract, spermatogenesis, and impotence and loss of appetite have been summarized in previous studies [5, 6]. Previous studies used weight measurement to assess the effect of khat chewing on the body [6]. However, data on the effect of khat on the different constituents of body mass i.e. body composition are lacking.

Body composition is a term used to describe the different constituents that make up a human's body weight. According to elemental, chemical, anatomical or fluid components, body composition investigation involves subdividing body weight into two or more compartments. The classic two-compartment model divides the body mass into fat mass and fat-free mass compartments. The fat mass comprises of all lipids, and the fat-free mass includes water, protein, and mineral components [7].

There are several different methods used to identify body composition, such as body mass index, skin folds and bioelectrical impedance analyses [8]. Bioelectrical Impedance Analysis (BIA) is an easy, cheap, valid and non-invasive method, in which resistance to a low electric current level with a frequency of 50 kHz is proportional to the percentage of FM [8,9].

Therefore, the main aim of the present study was to determine the association between body composition and khat chewing using questionnaires and anthropometric measurements advices.

## 2. Materials and Methods

### 2.1. Study Design and Population

A cross-sectional descriptive study was conducted from September to November 2023 among Medicine college and health sciences students of Department of Therapeutic Nutrition and Dietetics at University of Science and technology, Sana'a, Yemen.

### 2.2 Study population and sampling size

The included Managerial and academic were from all the Colleges of University of Science and technology, Sana'a, Yemen. Targeted sample size of 300 participants was estimated.

The sample size was calculated using single population proportion formula, assuming a confidence level of 95 and 10 % allowance for non-response rate. The proportion of overweight (P) plus obesity, which is 43.3 % (Over weight = 24.1 % and obesity = 19.2 %) taken from studies done in Tanzania [10].

### 2.3 Study tool development

The questionnaire was developed a thorough review of the relevant literature. The face and content validity of the questionnaire were examined by asking three experts their opinions regarding whether the items covered important aspects of the domains measured. The questionnaire had 5 sections: (1) the demographic profile of the participants; (2) general matters related to khat chewing; (3) reasons for chewing khat; (4) Number of hour's khat chewing and (5) The effect of khat chewing on meals times [9].

### 2.4 Data collection and types of measures used to measure the body

The data was collected a thorough interview with academics and administrators with using a structured self-administered questionnaire, using tape measure and anthropometrics devices for measure the body composition of participants, it included muscle mass, fat body, visceral fat, waist circumference and BMI [3].

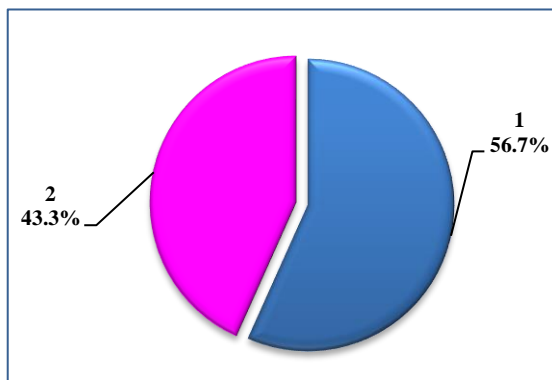
### 2.5 Statistical Analysis

The data collected from the questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSSVR) version 18.0 (SPSS Inc. Released 2009. PASW Statistics for Windows, Version 18.0. Chicago: SPSS Inc.). The frequency was measured for all the variables. The descriptive statistics, i.e. the frequencies (percentages), means (standard deviations, SDs) and medians (interquartile ranges, IQRs), were calculated.

## 3. Results

### 3.1 Distribution of participants according to habit of khat chewing

The current study has included 300 UST employees. 170, participants, representing 56.7% of the sample are khat chewers and 130, participants; representing 43.3% are non khat chewers (Figure 2).



**Fig 2.** Distribution of participants according to habit of khat chewing

### 3.2 Distribution of participants according to demographic characteristics

Results in table (1) indicate characteristics of the sample population. Males accounted for the majority at 72.3%, while females represented only 27.7% of the sample. The age distribution showed a range from 19 to 70 years, with the largest age group was 30-39 years at 40.7%. Marital status indicated that the majority of participants were married, making up 83.7% of the sample. Regarding job titles, 32.7% were in academic positions, while 67.3% held managerial roles. In terms of smoking habits, 13.3% of participants were smokers, while 86.7% were non-smokers. For physical activity levels, 28.3% reported

low activity, 62.7% engaged in moderate activity, and 9.0% had high levels of physical activity.

**Table 1:** Demographic characteristics of women participated in the study

Variable	Count (n=300)	Percent
<b>Khat chewing</b>		
Chewers	170	56.7%
Non-chewers	130	43.3%
<b>Gender</b>		
Males	217	72.3%
Females	83	27.7%
<b>Age (mean=38.7±9 years, range=19-70 years)</b>		
< 30 years	48	16.0%
30-39 years	122	40.7%
40-49 years	96	32.0%
>=50 years	34	11.3%
<b>Marital status</b>		
Single	49	16.3%
Married	251	83.7%
<b>Job title</b>		
Academic	98	32.7%
Managerial	202	67.3%
<b>Smoking</b>		
Smokers	40	13.3%
None smokers	260	86.7%
<b>Physical activity</b>		
Low	85	28.3%
Moderate	188	62.7%
High	27	9.0%

### 3.3 Characteristics of khat chewers

Results in Table (2) reveals characteristics of khat chewers. Out of 170 khat chewer individuals, the majority were males representing 88.8%, while females accounted for only 11.2%. The managerial persons representing 77.1%, while individuals in academic positions accounted for 22.9%. regarding physical activity levels, 27.1% reporting low activity, 61.8% engaging in moderate activity, and only 11.2% having high activity levels. The duration of khat chewing was predominantly long-term, with 90.0% of chewers having been engaged in the practice for two years or more. The frequency of khat chewing varied, with 45.3% reporting daily consumption. Participants spent an average of 4.5±2 hours per day in khat chewing sessions, with 52.9% spending 1-4 hours, 43.5% spending 5-8 hours, and 3.5% spending more than 8 hours. The majority of khat chewers reported spending around 2000 Yemeni Riyals (Y.R.) per day on khat. In terms of the impact on meal schedules, 38.8% stated that their schedule was affected by khat chewing.

**Table 2:** Characteristics of khat chewers

Variable	Count (n=170)	Percent
<b>Gender</b>		
Males	151	88.8%
Females	19	11.2%
<b>Job title</b>		
Academic	39	22.9%
Managerial	131	77.1%
<b>Physical activity</b>		
Low	46	27.1%
Moderate	105	61.8%
High	19	11.2%

**Table 2:** continued

Variable	Count (n=170)	Percent
<b>Duration since starting khat chewing</b>		
<2 years	17	10.0%
>/=2 years	153	90.0%
<b>Frequency of khat chewing</b>		
Everyday	77	45.3%
4-6 times/week	14	8.2%
2-3 times/week	43	25.3%
Once/week	36	21.2%
<b>Hours spent in khat chewing (mean=4.5±2 hours)</b>		
1-4 hours/day	90	52.9%
5-8 hours/day	74	43.5%
>8 hours/day	6	3.5%
<b>Cost per day</b>		
About 2000 Y.R.	121	71.2%
About 3000 Y.R.	29	17.1%
About 4000 Y.R.	8	4.7%
More than 5000 Y.R.	12	7.1%
<b>Effect of K. chewing of meals schedule</b>		
Affected	66	38.8%
Not affected	104	61.2%

**Table 4:** Comparing body composition between chewers and none chewers

Body composition	Chewers n=170	None chewers n=130	Diff [95% CI]	P value*
Muscle mass (mean± SD)	33±6	29.9±7	3.1 [1.6, 4.5]	<0.001
Body fat (mean± SD)	27.8±9	31±12	-3.2 [-5.6, -0.7]	0.001
Visceral fat (mean± SD)	9.3±4	7.8±4	1.5 [0.6, 2.4]	0.001
Waist circumference (mean± SD)	88.4±10	82.6±11	5.8 [3.4, 8.3]	<0.001
BMI (mean± SD)	25.9±4	24.9±4	1 [0.1, 1.9]	0.029

\*Independent t-test was applied.

**3.6 Comparing body composition between males and females chewers**

Results in table (5) present a comparison of body composition between male and female khat chewers. The results indicate significant differences between males (n=151) and females (n=19) in terms of muscle mass, body fat, visceral fat, and BMI (p values <0.05). Males had higher muscle mass (34.3±4 vs 22.7±2) and visceral fat levels (9.5±4 vs 7.5±2). However, females had higher body fat percentages (43.1±6 vs 25.9±8) and slightly

**3.4 Comparing physical activity between chewers and none chewers**

Results in table (3) indicate that about 60% of chewers and non-chewers have moderate physical activity. High physical activity is reported by 11.2% of chewers vs 6.2% of non-chewers. However, the difference is not statistically significant (p value >0.05).

**Table 3:** Comparing physical activity between chewers and none chewers

Physical daily activity	Chewers n=170	None chewers n=130	P value
Low	46 (27.1%)	39 (30.0%)	0.310
Moderate	105 (61.8%)	83 (63.8%)	
High	19 (11.2%)	8 (6.2%)	
Total	170 (100%)	130 (100%)	

**3.5 Comparing body composition between chewers and none chewers**

Results in table (4) reveal that khat chewers had higher muscle mass (33±6) compared to non-chewers (29.9±7), lower body fat percentages (27.8±9 vs. 31±12), higher levels of visceral fat (9.3±4 vs. 7.8±4), larger waist circumferences (88.4±10 vs. 82.6±11), and slightly higher BMI values (25.9±4 vs. 24.9±4). Differences are statistically significant as indicated by p values (all p values <0.05). These findings suggest that khat chewing may be associated with specific body composition characteristics, including increased muscle mass, lower body fat, higher visceral fat levels, and larger waist circumferences. It's important to note that these results are based on the specific sample studied and further research is needed for appropriate interpretation of these findings.

higher BMI values (27.9±3 vs 25.7±4). On the other hand, there was no significant difference in waist circumference between males and females. These findings suggest that there are gender-specific variations in body composition among khat chewers. It is important to note that these results are based on the specific sample studied and may not be representative of all khat chewers or the general population. Further research is needed to explore the underlying factors contributing to these gender-based differences in body composition among khat chewers.



**Table 5:** Comparing body composition between males and females chewers

Body composition	Males n=151	Females n=19	Diff [95% CI]	P value
Muscle mass (mean± SD)	34.3±4	22.7±2	11.6 [9.6, 13.6]	<0.001
Body fat (mean± SD)	25.9±8	43.1±6	-17.3 [-20.9, -13.6]	<0.001
Visceral fat (mean± SD)	9.5±4	7.5±2	2 [0.9, 3.1]	0.001
Waist circumference (mean± SD)	88.6±10	87.3±10	1.3 [-3.7, 6.3]	0.610
BMI (mean± SD)	25.7±4	27.9±3	-2.2 [-4.1, -0.4]	0.017

\*Independent t-test was applied.

#### 4. Discussion

The Figure 2 showed targeted sample size of 300 participants was estimated. As that khat chewers were more than non-chewers, this agrees with findings in Yemen [1]. These results indicated that 80.0% of men were khat chewers and 60.0% of women non-chewers. Other study showed that Khat chewing is highly prevalent in Yemen (82% among men and 43% among women) [11-14].

This is the second study that explored khat chewing among Yemeni women and men after Previous study of AL-abed *et al*, 2014 [3] (Table 2). Both of two studies showed that women were less likely to chew khat compared to those men. In the past few decades, khat chewing by women was considered unacceptable, but recently its use among women and children has increased and become socially accepted [15, 16]. It was thought that husbands were responsible for these changes because they encourage their wives to share them chewing khat [17] (Table 2).

Khat chewing was common among men of all age groups. Previous studies reported that khat chewing was associated with age, gender, residence, and occupation [18]. Other previous studies confirmed no association was found between khat chewing and employment status [1]. These results were not surprising, however, because the customary time for chewing khat usually begins after working hours in the evening.

Our results showed that khat chewers smoking less cigarette than khat chewers. These findings non-agree with previous studies reported that khat chewer's use smoking more than non-chewers due to potentiating effect of Khat chewing on cigarette smoking [19] (Table 2).

The previous studies showed that women were less likely to chew khat compared to men. In the past few decades, khat chewing by women was considered unacceptable, but recently its use among women and children has increased and become socially accepted [18, 19]. It was thought that husbands were responsible for these changes because they encourage their wives to share them chewing khat [20] (Table 3).

There are previous studies confirmed no association was found between khat chewing and employment status [1]. These results were not surprising, however, because the customary time for chewing khat usually begins after working hours in the evening (Table 4).

Our result showed that the most of khat chewers were nonsmokers and these findings not agree with previous studies reported that khat chewers use smoking more than non-chewers due to potentiating effect of khat chewing and cigarette smoking [21, 22], we can relate our result to participants awareness of association between smoking and health complications due to their level of education, but they cannot make avoidance to khat chewing because khat chewing is cultural habit in every society events (Table 4).

Our study in table 6 showed that khat chewers were higher muscle mass, body fat, visceral fat, waist circumference and BMI than non-chewers, this agrees with findings in Ethiopia [1]. These results indicated no relationship was found between khat chewing and muscle mass. Increased in muscle mass and BMI among khat chewers may be due to increase in food intake as a result of the lack of effects of khat on the meal schedule as shown in the (Table 3). On the other hand, this study also confirmed that higher visceral fat and waist circumference in khat chewers were associated with poor physical activity and intake some sweetened beverages, thus expending less energy [22]. In addition to, individuals who use both khat and cigarette had higher visceral fat. This may be related to the potentiating effect of Khat chewing on cigarette smoking [23-26].

Also, our study indicated no relationship was found between khat chewing and excess body fat. Previous studies confirmed that the effects of khat on body fat are still inconclusive [19, 20].

In addition to, there is no significant association between khat chewing status and excess body fat. Similarly, marital status, job title, smoking status, duration since starting khat chewing, frequency of khat chewing, and hours spent in khat chewing where a study by [19] showed that the effects of khat on body fat are still unknown.

## 5. Conclusion

Our results showed that khat chewers are more than non-chewers among employees of the University of Science and Technology, Sana'a, Yemen.

Current study confirmed that khat chewers had higher muscle mass, lower body fat percentages, higher levels of visceral fat, larger waist circumferences and slightly higher BMI values compared with non-chewers. In addition to, males khat chewers had higher muscle mass, higher visceral fat levels, higher waist circumferences values compare with females were muscle mass, visceral fat levels and waist circumferences low. Also, there is no significant association between khat chewers and excess body fat.

The physical activity of khat chewers was higher than non-chewers. As about 45.3% of participants chewing khat daily. As well as, about 71.2% of participants spend 2,000 riyals daily to buy khat and chewing it. 61.2% also reported of the participants, khat no affects meal times.

## 6. Acknowledgments

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## 7. Ethical approval

An ethical statement was approved by Dept., Nutrition and Therapeutic Dietetics, Medicine Faculty and Health Sciences, University of Science and Technology, Sana'a, Yemen to start samples collection. The purpose and procedure of this study was well explained in the Arabic language to the participants before data collection. All participation was voluntary. All information that was obtained from participants was available only to the researchers.

## 8. Conflict of interest statement

The authors declare no conflicts of interest.

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## دراسة العلاقة بين تركيب الجسم ومضغ القات ضمن موظفين جامعة العلوم والتكنولوجيا، صنعاء، اليمن

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## المُلخَص

القات (*Catha edulis* Forsk) نبات ينمو بشكل شائع في الجمهورية اليمنية، ويمضغ الناس أوراق القات الصغيرة لمفعولها المنشط، ولا يُعرف إلا القليل عن العلاقة بين مضغ أوراق القات وتكوين الجسم. شارك في الدراسة 300 موظف/موظفة (أكاديميين وإداريين) من جامعة العلوم والتكنولوجيا، صنعاء، اليمن، تتراوح أعمارهم بين 19-70 سنة، وتم جمع البيانات الديموغرافية وتكوين الجسم والنشاط البدني باستخدام استبيانات منظمة وأجهزة قياسات الجسم البشرية. وتم تقدير كتلة العضلات (كجم) ودهون الجسم (كجم)، والدهون الحشوية (كجم)، ومحيط الخصر (سم) ومؤشر كتلة الجسم (كجم / م<sup>2</sup>) باستخدام المخططات الصحية لمنظمة الصحة العالمية. أظهرت الدراسة الحالية أن عدد الذين يمضغون القات كان 170 فرد (56.7%) مقارنة بالذين لا يمضغون كان عددهم 130 فرد (43.3%). كان متوسط  $SD \pm$  عمر المشاركين  $38.7 \pm 9$  سنوات، يشمل 217 (72.3%) ذكور و 83 (27.7%) من الإناث، منهم 40 فرد (13.3%) مدخنين و 260 (86.7%) غير مدخنين. في حين أن 151 (88.8%) من الرجال و 19 (11.2%) من النساء يتعاطون القات، بما في ذلك 39 (22.9%) أكاديميين و 131 (77.1%) غير أكاديميين. بالإضافة إلى ذلك 46 (27.1%) لديهم نشاط منخفض و 105 (61.8%) لديهم نشاط معتدل و 19 (11.2%) لديهم نشاط مرتفع. قدر عدد المشاركين في مضغ القات بشكل يومي 77 (45.3%)، في حين كان 14 (8.2%) يمضغون القات من 3-6 مرات اسبوعياً، 43 (25.3%) يمضغون القات من 2-3 مرات اسبوعياً، بينما 36 (21.2%) يمضغون القات مرة واحدة/أسبوع. يقضى المشاركون في المتوسط  $4.5 \pm 2$  ساعة يومياً في جلسات مضغ القات، حيث قضى 52.9% منهم 1-4 ساعات، و 43.5% قضوا 5-8 ساعات، و 3.5% قضوا أكثر من 8 ساعات. وأفاد غالبية من يمضغون القات أنهم ينفقون حوالي 2000 ريال يوميًا على القات. كما أفاد 38.8% من المشاركين أن القات يؤثر على مواعيد الوجبات. يمتلك ماضغين القات كتلة عضلية أعلى ( $33 \pm 6$ )، ونسب دهون أقل في الجسم ( $27.8 \pm 9$ )، ومستويات أعلى من الدهون الحشوية ( $9.3 \pm 4$ )، ومحيط خصر أكبر ( $88.4 \pm 10$ )، وقيم مؤشر كتلة الجسم أعلى ( $25.9 \pm 4$ ) مقارنة مع الذين لا يمضغون القات كانت كتلة العضلات ( $29.9 \pm 9$ ) ونسب الدهون في الجسم ( $31 \pm 12$ ) ومستوى الدهون الحشوية ( $7.8 \pm 4$ ) ومحيط الخصر ( $82.6 \pm 11$ ) وقيم مؤشر كتلة الجسم ( $24.9 \pm 4$ ). بالإضافة إلى ذلك، يمتلك الذكور الذين يمضغون القات كتلة عضلية أعلى، ومستويات أعلى من الدهون الحشوية وقيم محيط الخصر أعلى مقارنة بالإناث حيث كانت كتلة العضلات ومستويات الدهون الحشوية ومحيط الخصر منخفضة. وأخيراً، أظهرت دراستنا بأنه لا توجد علاقة ذات دلالة إحصائية بين حالة مضغ القات وزيادة الدهون في الجسم.

الكلمات المفتاحية: مضغ القات، كتلة العضلات، دهون الجسم، الدهون الحشوية، محيط الخصر، مؤشر كتلة الجسم.

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