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Does Chewing gum Affect Stress in Healthy People? A Systematic Review on Clinical Trials

Abstract

There are various reasons for chewing gum, involving regulating psychological states such as concentration and alertness. More recent studies have shown inconsistent findings on the effects of chewing gum on stress reduction. This systematic review was conducted to investigate the effect of gum chewing on stress in different stressful situations in randomized controlled clinical trials. To find the main question in this study, the PICO strategy was applied. Multiple databases were systematically examined without considering time restrictions to perform relevant randomized controlled clinical trials of chewing gum and stress until February 2021. Of 108 papers found at the beginning of the study, only three studies were considered appropriate for a systematic review based on inclusion criteria. The results revealed that perceived stress is reduced due to chewing gum. Based on current evidence from three studies, chewing gum can reduce stress. Therefore, chewing gum can be recommended as a safe tool to alleviate stress.

Keywords: *Gum, Chewing, Stress, Review*

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Introduction

Everyone may occasionally experience stress in their lives which influences health through responses of autonomic and neuroendocrine via alternation in healthy behaviors.[1] Stress describes a condition in which the body's homeostasis is compromised, during which various adaptation processes are activated to cause physiological and behavioral changes.[2] It is regarded as a type of response to physical and psychological stressors.[3]

In response to stress, the neural activity of the hypothalamus-pituitary-adrenal axis increases, which leads to the release of the adrenal cortex hormone (cortisol). [4] In addition, cortisol is used as a biomarker of stress, and its levels in saliva are usually one of the best markers for assessing stress. [5]

Lowering stress levels is significant in preventing sudden death in patients with cardiovascular disease because stressful situations can motivate imbalance in autonomic actions and cause fatal arrhythmias.[6]

Chewing represents a chief biological action that starts the ingestion and digestion process, affecting the body as a whole.[7] There are various reasons for chewing gum, involving regulating psychological states such as concentration and alertness.[8]

The impacts of chewing gum on mood and performance were first examined in the form of a candy-coated chicle in the 1930s. Hollingsworth studied his subjects under three conditions: chewing gum, not chewing, and sucking a candy. In all his experiments, the subjects rated themselves, and findings demonstrated they were more relaxed in the chewing gum conditions compared to other situations.[9]

Contrary to the results of Hollingsworth's study, Freeman proved that the effects of chewing gum on relaxation are similar to those of foot-tapping, based on which he concluded both chewing gum and foot-tapping produce extra energy and further, he asserted this effect isn't only specific to chewing gum.[10] Research has shown that the endocrine system response is affected by chewing gum and that increasing the frequency of gum chewing is associated with reduced stress.[11] More recent studies have presented inconsistent findings on the effects of chewing gum on stress reduction.[12, 13] Therefore, researchers decided to conduct a systematic review to examine the effect of chewing gum on stress in healthy people in clinical trials.

Materials and Methods

Based on the Preferred Reporting Items for Systematic Reviews and Meta-analyses statement, this literature review was conducted to certify its quality.[14] Systematic literature searches were performed to identify all randomized clinical trials on chewing gum and stress. To find the main question in this study, the PICO strategy was applied.[15]

Population: Healthy people who were either stressed or in a stressful situation ranged in age from 18 to 40.

Intervention: Chewing gum

Comparison: Compared to the placebo or the control group

Outcome: Stress

In summary, the search strategy included the following:

Search strategy

Computerized literature databases included Cochrane Library, ISI Web of Science (www.webofknowledge.com/), MEDLINE (source: PubMed; https://www.ncbi.nlm.nih.gov/pubmed/), Scopus, and Google Scholar (all from their beginning to February 2021). A comprehensive search strategy of appropriate MeSH terms and/or text words for randomized controlled trials was applied (RCTs; randomized, clinical trials/ controlled/placebo-controlled). Using the following keywords, the databases were searched to find relevant studies:

- Gum, chewing, stress, stressor, anxiety

To identify more related studies, reference lists of all chosen studies were also examined. There was no limit to language or the year of publication. In PROSPERO, the registration number of the current systematic review is CRD42021239856.

Study selection

Based on the following criteria, the RCT articles were selected (inclusion criteria): (1) females or males from 18 to 40 years old, (2) studies that assessed the effect of chewing gum on stress, (3) studies in which subjects were either stressed or in a stressful situation, (4) studies in which stress was measured only by a perceived stress questionnaire, (5) studies in which chewing gum was sugar-free, (6) studies in which chewing gum lasted at least 20 minutes a day, (7) studies in which the study period was ≥ 2 days, and (8) studies in which data were recorded at the beginning and the end of the study in both control and intervention groups or group changes.

Exclusion criteria included the followings:

(1) uncontrolled trial, (2) studies that did not provide enough information, (3) studies that were based on something other than chewing gum, (4) studies in which the participants consisted of patients with mood disorders like anxiety and depression.

Data extraction

First, two of the researchers (A. M. and Z. S.)examined the title and abstract, then assessed the full texts of the chosen papers to select the qualified papers for systematic review (Fig. 1). The papers that did not meet the inclusion criteria were excluded. If there was a disagreement between two researchers about choosing a study, the third researcher (S.H.) was asked to help. Finally, three studies were selected.[8, 13, 16]

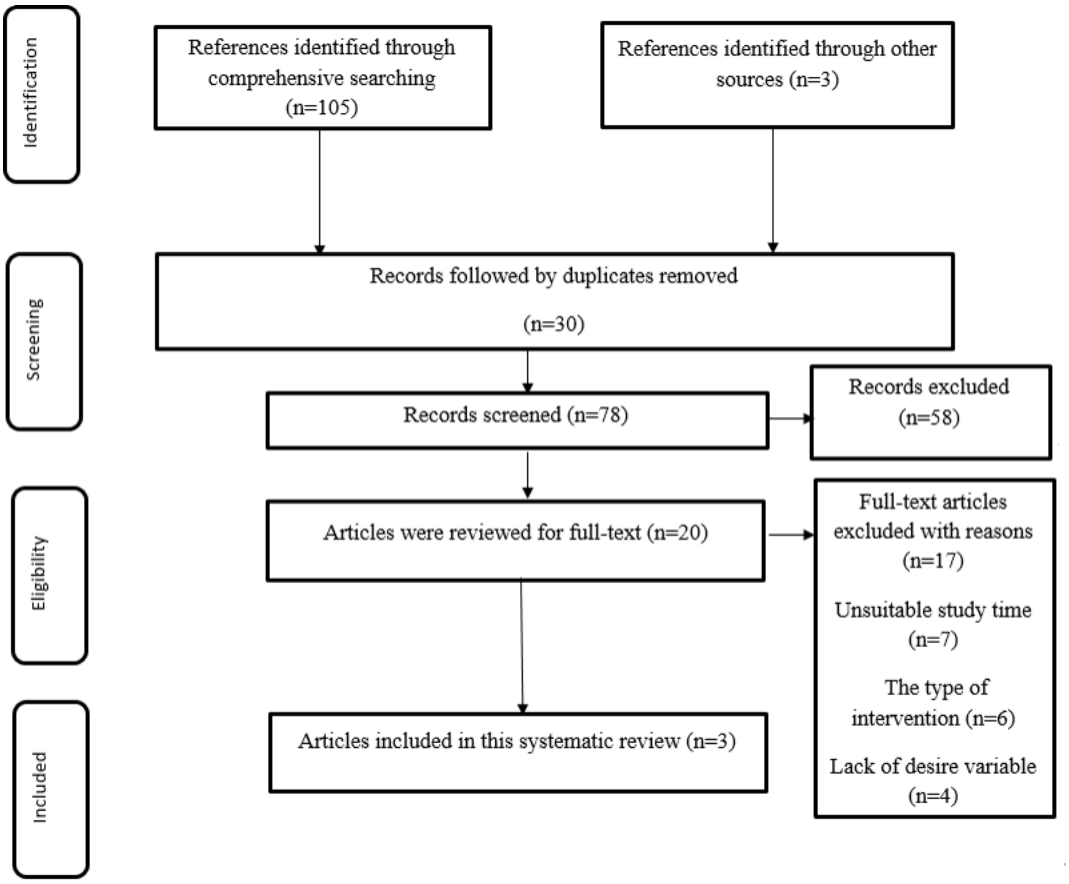

Figure.1 The PRISMA flow diagram for literature search and study selection.

Quality assessment

The quality of the selected studies was independently investigated by two researchers (Z. S. and S. H.). By applying the Cochrane Collaboration's tool, the methodological quality was evaluated [17](Table 1), which contains six domains of bias: “Selection bias”: random sequence generation and allocation concealment, “Performance bias”: blinding of participants and personnel, “Detection bias”: blinding of outcome assessment, “Attrition bias”: incomplete outcome data, “Reporting bias”: selective reporting, “Other bias”: Other sources of bias. For each item, the risk of bias was low, high, and uncertain. The overall quality of each of the trials was arranged into three categories: weak (low risk for less than two items), fair (low risk for two items), or good (low risk for more than two items).[18]

Table 1. Quality of included studies assessed by the Cochrane collaboration's tool

Reference	Selection bias		Performance bias	Detection bias	Attrition bias	Reporting bias	Other sources of bias	score	Overall quality
	Random sequence generation	Allocation concealment	Blinding of participants, personnel	Blinding of outcome assessment	incomplete outcome data	Selective outcome reporting	Assessment of supplement compliance		
Smith and Woods, 2012 [16]	Unclear	High	High	Unclear	Low	Low	Low	3	Good
Yaman-Sözbir et al., 2019 [8]	Low	High	High	Unclear	Low	Low	Low	4	Good
Smith and Clayton, 2020 [13]	Unclear	High	High	Unclear	Low	Low	Low	3	Good

Results

Literature search and study characteristics

In Figure 1, an overview of the selected papers is demonstrated. One hundred eight studies were found with the study reference lists and the primary search strategy. Thirty records were excluded by duplicate removal and based on titles and abstracts, 78 papers were evaluated. From 20 papers chosen for full-text review, 17 studies were excluded due to the type of intervention and lack of inclusion criteria.[3, 19-34]

Finally, three studies were qualified to be considered in this systematic review.[8, 13, 16] Table 2 summarizes the chosen studies' specifications. The total sample size included 208 participants. One study was a cross-over design, and two studies were parallel RCTs. The duration of the intervention ranged from 20 minutes for two days [13] to 30 minutes for 19 days.[8] Due to the nature of the intervention, chewing gum was avoided in the control group of all studies.

Table 2. Summary of Characteristics of Included Studies

Study	Location	Mean age	No. of participants (intervention/control)	Sex (female/ male)	Type of intervention	Intervention	Follow up duration	Study Design	Control group	Outcome measure	Results
Smith and Woods, 2012 [16]	UK	19.5	37/35	NM	A variety of flavors from the Wrigley's sugar-free range	Students were in chewing or not chewing gum conditions	For 20 minutes a day for 14 days	2 parallel groups	Not chewing gum	Self-rated stress by a perceived questionnaire	Chewing gum decreased stress.
Yaman-Sözbir et al., 2019 [8]	Turkey	20.5	67/33	81/19	Sugar-free and mastic gums	chewing gum for 7 days and 19 days in two groups and not chewing gum in the other group	For 30 minutes a day for 7 days and 19 days	three parallel-groups	Not chewing gum	Self-rated stress by questionnaire	Chewing gum reduced exam stress.
Smith and Clayton, 2020 [13]	UK	NM	18/18	NM	A range of flavors from the Wrigley's sugar-free Extra and Extra Ice range	Each student was in both chewing gum and not chewing gum conditions and also located in high-load and low-load work situations	For 20 minutes a day for 2 days	cross-over	Not chewing gum	Self-rated stress by a perceived questionnaire	Chewing gum alleviated stress.

NM: Not mentioned.

Quality assessment

The summary of the quality assessment of the trials is shown in Table 1. Based on the Cochrane Collaboration tool, all of them [8, 13, 16] had a good score.

Qualitative synthesis

The results of the current systematic review are listed below based on conducted RCT research.

The effect of chewing gum on stress

The effect of chewing gum on stress has been examined in all three studies. As shown in Table 2, one study used a crossover design [13], and two used a parallel design.[8, 16] As previously mentioned, the duration of the intervention ranged from 20 minutes for two days [13] to 30 minutes for 19 days.[8] In all studies, chewing gum has been shown to reduce stress.

Discussion

The effect of chewing gum on stress in healthy people was examined using three RCTs in this systematic review. The results revealed that chewing gum could lead to stress reduction. In this regard, it can be stated that the extensive areas of the brain are activated by chewing [35], and also, it can be expressed that chewing delicious foods like gum with good odor and taste can make you feel pleasant and motivate reward systems in the brain.[3]

Chewing gum enhances the transference of oxygen and glucose to the cerebral.[33] There is evidence that elevating glucose metabolism in the medial prefrontal cortex is associated with lower salivary cortisol.[30] Also, it has been observed that chewing gum decreases the action of stress-related parts of the brain while reducing cortisol release.[28] Cortisol is a hormone with an evident diurnal pattern [36]. Its level increases immediately when a person wakes up, decreases during the day, and reaches its lowest level in the evening.[31] In total, cortisol is regarded as a good marker of stress and alertness.[32]

Smith showed that chewing gum increases the level of cortisol, which demonstrates elevated physiological stress reaction. However, the participants reported less anxiety in chewing gum situations.[32] On the contrary, Scholey et al. proved that chewing gum decreases cortisol levels.[31] In Tahara et al.'s study, the amount of decline in salivary cortisol was 15.4% and 24.6% following chewing for 10 and 20 minutes, respectively.[37] Since the duration of chewing gum was different in the two mentioned studies (90 minutes versus 20 minutes), this could be another reason for the difference in their results.

In a study, it was found that 41% of students chew gum when they feel stressed.[38] All participants in this systematic review were students, and the results showed chewing gum could reduce stress. So, chewing gum can be considered a safe method for reducing stress in students.

Continuous chewing gum may reduce stress through acute effects, and stress may also be affected by chewing gum via neurotransmitter effects like serotonergic neurons.[28] Serotonin plays an essential role in the adjustment of emotion. Impairment of serotonergic systems leads to stress-related affective disorders.[39] However, it has been observed that chewing gum can reduce stress in people who chew gum regularly and in people who chew it occasionally.[32]

An important point about the impact of chewing gum on stress is its duration. In one study, the findings showed chewing gum cannot decrease stress. This study revealed that chewing for 5 minutes in stressful situations may be considered an inadequate time to alleviate stress.[9] In another study, it has been demonstrated that chewing gum for 20 minutes in stressful conditions can decrease stress.[31] Furthermore, Tasaka et al. showed that chewing gum continuously for 10 minutes can reduce stress.[40] Also, Yaman-Sozbir et al. indicated in their study that chewing gum for 30 minutes could reduce stress on exam days.[8] It can be concluded that chewing gum reduces stress when the chewing duration is relatively long.[41]

Regarding whether the effect of chewing gum on stress is dose-dependent or not, one study has shown that the impact of chewing gum on stress was a dose-dependent linear relationship so that people who chew gum for ≥5 days experienced less stress in life and in the work environment.[30]

In addition to its impact on stress, chewing gum can affect alertness by a temporary increment in the beta function of the frontal and temporal areas, which is related to alerting conditions.[42] Research has demonstrated our daily life can be affected by alertness.[43] So, chewing gum can improve the quality of life by increasing alertness.

Conclusion

In conclusion, studies have shown that chewing gum affects stress and can reduce it. Therefore, chewing gum can be used as an easy way to alleviate stress. Also, it is recommended that future studies be focused on understanding and extracting the mechanisms by which chewing gum affects stress and use more validated tools to show stress instead of using a perceived stress questionnaire. Additionally, in the examined studies, the majority of subjects involved students. Therefore, it is suggested that the effect of chewing gum on stress be investigated in other groups as well. Finally, since most studies used a short-term intervention, it is proposed to investigate the effect of chewing gum on stress over a long-term period.

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Ethics statement

None.

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Conflict of interest

There are no financial conflicts of interest to disclose.

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