TYPES OF SNACK INTAKE ASSOCIATED WITH STRESS AMONG ADULTS: A SCOPING REVIEW

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Abstract

Introduction: Overweight and obesity are significantly related to other health disorders or diseases such as non-communicable diseases. The determinants of these conditions are influenced by various factors particularly dietary habit and pattern. Excessive snack consumption high in fat, sugar and energy are common among adults in which play a major role to positive energy balance; resulting in increased risk of aforementioned problems stated. The objective of this study is to review the association between the types of snack intakes and stress in the adult population. Specifically, this study aims to investigate the preferences and choices of snack intakes among adults during periods of stress and identify the relationship between snack intakes and stress with its contributing factors. **Methods:** Preferred Reporting Items for Systematic and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) was applied as a method to review potential articles from four databases (Scopus, ProQuest Health and Medical Collection, Oxford Journals, and PubMed). **Results:** Twelve relevant articles were included in this review. Four themes were extracted from the included studies representing the most preferred till the least: (1) highly palatable and energy dense; (2) sweet; (3) savory; and (4) healthier options. Most studies found significant positive association between snack intakes and stress among adults particularly for the first three themes; except for the fourth theme. The contributing factors of snacking during periods of stress among adults can be identified into individual and environmental factors. **Conclusion:** This review provides evidence on the types of snack intakes associated with stress in the adult population and its contributing factors. This information can be utilized by the health agencies to plan and conduct appropriate intervention in the future in this population. Approaches to mitigate and prevent non-communicable diseases can be subsequently implemented to improve overall health in general.

Keywords: Snacks, Adults, Stress

Introduction

Snacking is not an uncommon habit and becomes familiar among people regardless of life stage, gender and race all around the globe. Snacking can be controversial whether it can cause desirable or adverse health outcomes. However, the result and effect might be varied depending on how snacking is consumed such as time (with regular meal or in between meal), quantity (more or

less), type of foods (high fibre, sugar, salt or fats); as well as snack preparation methods or technique (boiling, fried, grilled, etc), calorie or energy intake (high or low).

As a person grows up and experiences a transition of life phase or stage such as adolescence to young adulthood and young adulthood to middle adulthood; they eventually will be exposed and vulnerable to stressors such as challenges, obstacles, difficulties and problems in life. Moreover, adulthood is an eye-opening experience to the real world with many stressful life events related to various aspects. Not to mention, snacking is one of the most preferred ways or options for people nowadays to compensate or relieve stress to achieve a bit of calmness or peace of mind prior to or during stressful life events; although Reichenberger et al. (2021) highlighted that stress may lead to either increase or decrease food intake.

Snack consumption has shown an increased trend which leads to weight gain and obesity (Zenk et al., 2014). Previous studies also proved that characteristics of snacks nowadays are generally high in fat, sugar and salt such as processed foods. Emergence or development of obesity can be due to many causes. However, the essence of this complex and multifactorial disorder can be associated with imbalance of energy intake such as over snacking. According to the National Health and Morbidity Survey (NHMS) 2019 as reported by Institute for Public Health (IPH, 2020), Ministry of Health Malaysia has identified alarming prevalence of obesity in adults.

Due to this concern, this scoping review is essential as an effort, approach and motive to mitigate and reduce obesity rate and the occurrence of non-communicable diseases (NCDs) particularly related to diet by primarily targeting to identify the types of snack intake; as well as investigating the patterns, contributing factors and snack preference among adults. Moreover, it provides reference and guide to plan preventive approaches in the future in context with the availability of important information and findings from this review. Furthermore, this review emphasizes the relationship between diet and psychological health, snack intakes and stress among adults which can be the key focus to educate and promote health education and healthy diet among communities in the long-term period as suggested in many studies (O'Connor et al., 2015). Most importantly, scoping review has never been performed on this topic and previous review conducted by Araiza and Lobel (2018) was a narrative review.

Hence, this review primary objective was to investigate types of snack intake associated with stress among adults; and to further identify the preferences and choices of snack intakes among adults during period of stress and its contributors.

Method

This scoping review applied the Preferred Reporting Items for Systematic and Meta- Analyses extension for Scoping Reviews (PRISMA-ScR) method which was conducted by using the flow

diagram and checklist (Tricco et al., 2018). The steps involved in this review were identification, screening, eligibility and included.

Selection of studies

Records were identified through four (n=4) online databases namely Scopus, ProQuest Health and Medical Collection, Oxford Journals, and PubMed with no limitation of year. The databases were used to identify and search related literature which link between elements of stress and snacks intake in the adult population. Population, concepts, and context (PCC) framework was applied to identify the main elements in primary review questions. The search terms used for this review are shown in Figure 1 which applied Boolean Operators as part of search strategy to find relevant articles by inserting the keywords that are appropriate in the search engine.

Figure 1. Search term used in the review

(snack*) AND (stress* OR "emotional pressure" OR "mental pressure" OR tension) AND (adult* OR adulthood OR "young adult*" OR "college* student*" OR "universit* student*" OR middle-age OR elder*OR old* adult* OR elderly OR men OR women) NOT (children OR youth OR toddler* OR pediatric OR paediatric OR adolescent*)

The next step after the articles have been identified by using the selected databases; the articles were recorded, exported and screened by using Mendeley Software to remove the duplication of journal articles. The duplicates were excluded and not counted for the upcoming record. Once the duplicates have been removed, the remaining full-text articles were assessed for their eligibility. The eligibility involves identification of the inclusion and exclusion criteria. Table 1 shows the inclusion and exclusion criteria for this scoping review. The criteria are important components to decide whether the full-text articles will be included for the next step or excluded with specific reasons.

Table 1. Inclusion and exclusion criteria for this review

Inclusion Criteria	Exclusion Criteria
- Human study	- Animal study
- Adult population	- Children and adolescent population
- Study published in English	- Study published other than English
	- Adults who have been diagnosed with eating disorder or any psychiatric condition.
	- Hospitalized adults or patients.

Finally, the remaining data were included in the scoping review after discarding the full-text articles that did not match the criteria. Data from the studies were synthesized qualitatively using thematic analysis approach for the main research objective.

Data analysis

The findings and important data from this review were tabulated in the summary table. The table was specifically formulated to meet the objectives of the review. There are several elements that need to be extracted including (1) title, author, and year; (2) setting, age, sample size, and gender; (3) study design; (4) study objective; and (5) research findings comprise of: a) the relationship between snack intakes and stress among adults; b) contributing factors to snack; and c) preferences and choices of snack intakes during periods of stress. The table was used to facilitate the qualitative synthesis of the included studies.

Results

Overview of identified studies

A total of 836 records were obtained from the database search. After the removal of duplicates (n=150), screening of titles and abstracts was performed which then resulted in elimination of another 611 publications. Next, 75 remaining articles were evaluated based on inclusion and exclusion criteria by reviewing the full text articles. Finally, after full text articles were examined, 12 studies were included for qualitative synthesis of data. Figure 2 presents the process involved in accordance to PRISMA-ScR.

All relevant data from the 12 studies were extracted and tabulated in Appendix 1. The content of the summary table includes the title, author, year, setting, age, sample size, gender, study design, and research findings pertaining to the scoping review objectives.

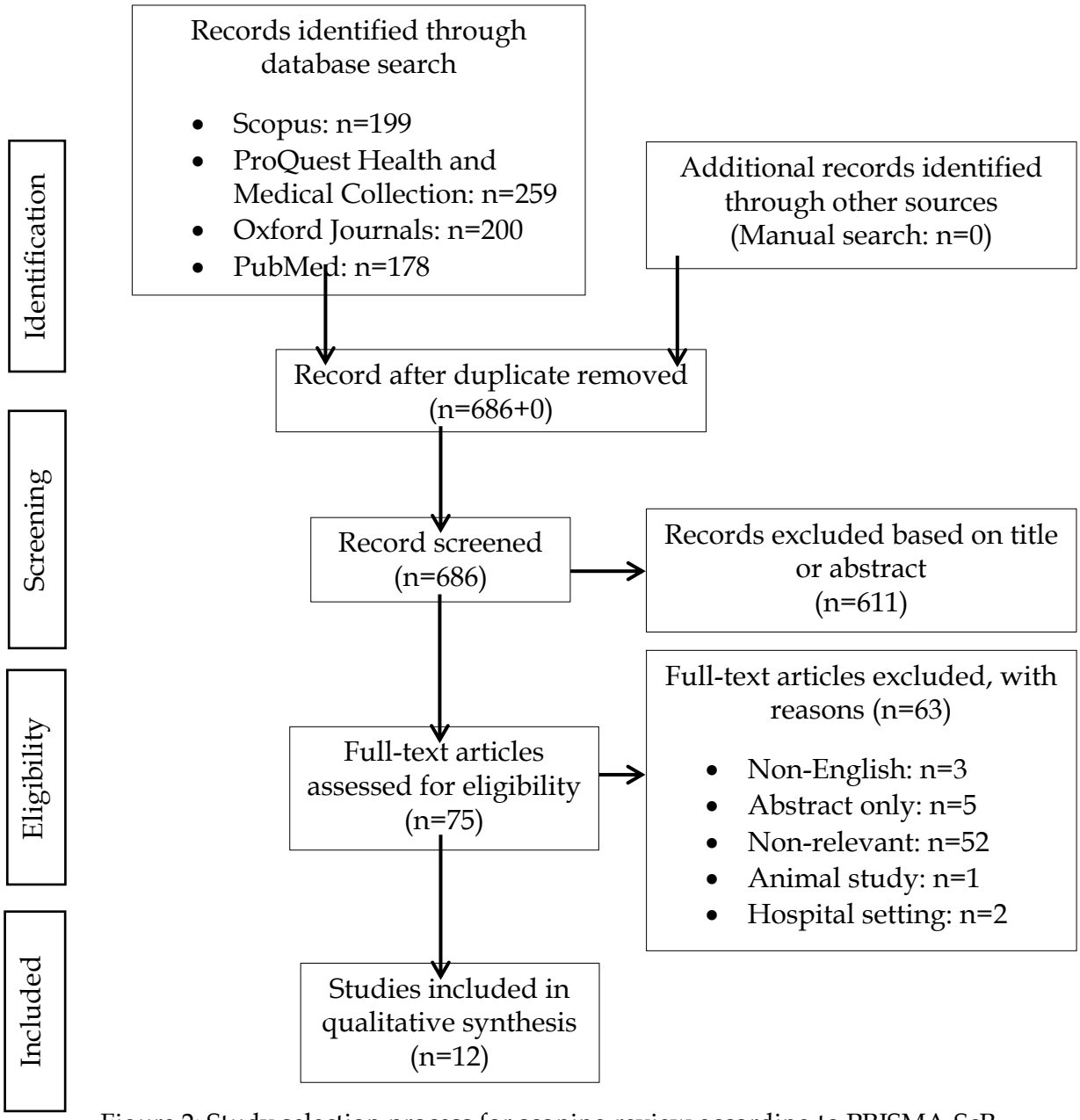

Figure 2: Study selection process for scoping review according to PRISMA-ScR

Thematic analysis of study findings

Themes were generated and emerged related to types of snack consumption associated with stress as reported in the twelve (n=12) included studies. Hence, the identified foods and beverages were defined and classified according to their respective criteria and features. Four themes were identified: (1) highly palatable and energy dense; (2) sweet; (3) savory; and (4) healthier options which had been extracted from the data listed in Appendix 1 under the research findings, preferences and choices of snack intakes during periods of stress. The definition for each theme becomes the core reference for the thematic analysis. Anguah et al. (2017) defined highly palatable and energy dense foods as high content of fat as the main ingredients followed by high in sugar and/or salt, dense with calories and becoming more appetizing with frequent consumption. Savory snacks can be defined as umami, which is also identified as monosodium glutamate (MSG) and provides a salty taste (Henney, Taylor & Boon, 2010). Besides, most savory snacks contain high sodium which contributes from added salt.

From the 12 studies, 11 preferred highly palatable and energy snacks (Oliver & Wardle, 1999; O'Connor & O'Connor, 2004; Zenk et al., 2013; Zenk et al., 2014; O'connor, Armitage & Ferguson, 2015; Almajwal, 2016; Kuczmarski et al., 2017; Wouters et al., 2018; Mohamed, Mahfouz & Badr, 2020; Chee et al., 2020; Kim, Lee & Song, 2021), 11 preferred sweets snacks (Oliver & Wardle, 1999; O'Connor & O'Connor, 2004; Zenk et al., 2013; Zenk et al., 2014; O'connor, Armitage & Ferguson, 2015; Kuczmarski et al., 2017; Wouters et al., 2018; Mohamed, Mahfouz & Badr, 2020; Chee et al., 2020; Kim, Lee & Song, 2021; Smith et al., 2021), 9 preferred savory or salty snacks (Oliver & Wardle, 1999; O'Connor & O'Connor, 2004; Zenk et al., 2013; Zenk et al., 2014; O'connor, Armitage & Ferguson, 2015; Kuczmarski et al., 2017; Mohamed, Mahfouz & Badr, 2020; Chee et al., 2020; Smith et al., 2021), 3 preferred fruits (O'connor, Armitage & Ferguson, 2015; Almajwal, 2016; Smith et al., 2021) and 1 preferred vegetables among the studied population (Almajwal, 2016). Appendix 2 highlights the summary of findings from thematic analysis and specific types of food.

The Relationship between Snack Intakes and Stress among Adults

10 of 12 studies showed significant positive association between snack intakes and stress among adults (Oliver & Wardle, 1999; O'Connor & O'Connor, 2004; Zenk et al., 2014; O'connor, Armitage & Ferguson, 2015; Almajwal, 2016; Kuczmarski et al., 2017; Wouters et al., 2018; Mohamed, Mahfouz & Badr, 2020; Chee et al., 2020; Kim, Lee & Song, 2021). A study reported significant negative association between stress and healthier option (Almajwal, 2016); in which greater stress level associated with lower fruits and vegetable intake. Meanwhile, there were 3 studies which did not present significant association (Zenk et al., 2013; O'connor, Armitage & Ferguson, 2015; Smith et al., 2021).

Contributing factors to snacks intake

The details regarding contributing factors to snack can be extracted from 6 studies (Zenk et al., 2013; Zenk et al., 2014; Almajwal, 2016; Mohamed, Mahfouz & Badr, 2020; Chee et al., 2020; Smith et al., 2021) while the remaining studies did not assess this variable (Oliver & Wardle, 1999; O'Connor & O'Connor, 2004; O'connor, Armitage & Ferguson, 2015; Kuczmarski et al., 2017; Wouters et al., 2018; Kim, Lee & Song, 2021). Based on data available from the studies, the contributing factors of snacking were related to individual factors (taste, price, food motivation, socioeconomic status and stress coping mechanism) and environmental factors (location, availability and accessibility).

Level of evidence

The Joanna Briggs Institute (JBI) Level of Evidence 2014 was used to describe the strength of the evidence of the twelve included studies. JBI assigns levels 1 to 5 (Level 1- Experimental Designs, Level 2- Quasi-experimental Designs, Level 3- Observational–Analytic Designs, Level 4- Observational–Descriptive Studies & Level 5- Expert Opinion and Bench Research). With regards to level of evidence of all the 12 studies; 11 cross-sectional studies and 1 mixed-method study were identified as level 4.

Discussion

Types of snack intake associated with stress among adults

Four themes emerged regarding types of snack intake associated with stress among adults namely highly palatable and energy dense, sweet, savory and healthier option. Zellner et al. (2006) demonstrated the food types consumed in the periods of stress basically favour those of high fat, energy-dense and/or high sugar amount as commonly feature in snack foods. Eventually, in the absence of hunger or other biological cues people prefer high palatable foods including snacks, processed foods, and energy-dense foods (Rutters, 2009). Stress potentially influences irregular eating pattern and reinforce unhealthy diet such as hedonic overeating which may be worsen among overweight or obese individuals compared to normal or healthy individuals (Block et al., 2009; Yau & Potenza, 2013).

The results obtained from the included studies showed both consistent and inconsistent findings with previous literatures in any events or situations. For instance, Kiefer, Rathmanner and Kunze (2005) stated that women commonly related to frequent food intakes (main meal and/or snacking) especially during the period of stress compared to men. This finding was parallel to several other studies conducted by Oliver and Wardle (1999), Mohamed, Mahfouz and Badr (2020) and Kim, Lee and Song (2021). Furthermore, the researchers further elaborated common food preferences among women which include rich in fat (highly palatable and energy dense) such as cakes and biscuits and high sugar content as well as sweet such as chocolate; which

supported the results in several studies of the review. In the same study, men were found to be preferred on foods high in sugar compared to women. Nevertheless, this finding was not associated with stress among the studied population. However, it provided illustration and a similar pattern which can be identified in the majority of the studies reporting preferred sweet snack types among male population.

Women were also reported to consume plenty of healthier foods such as fruits and vegetables (healthier option) which presented the opposite finding compared to other studies in this review (Kiefer, Rathmanner & Kunze, 2005). However, this claim was independent of stress and not focusing on snack intake only. The researchers also explained this positive quality regarding healthier food consumption was related to better understanding and highly aware of nutrition knowledge in the same study. However, studies included in this review did not conduct any assessment related to nutrition knowledge or awareness. In the previous literature, it was stated women were inclined to follow a healthy diet consisting of fruits and vegetables compared to men based on all-European sample study (Margetts et al., 1997). Three included studies focusing on healthier option snack types did not show any association between gender and consumption of this snack type during the period of stress.

Contributing factors to snacks intake

There were studies emphasizing snack availability as evidenced by strategic locations or nearby to the snacks source, various stores selling or providing snacks as contributing factors to snacking among sample population (Zenk et al., 2013; Zenk et al.,2014). These findings supporting the claims from several studies that high availability of foods may lead to higher exposure of snacks that were sold at nearby stores, premises or restaurant to the potential consumers despite in the absence of hunger and need to eat; which subsequently encouraging unnecessary snacking among people even could influence people to develop this habit particularly among "non-snackers' (Mielmann & Brunner, 2018).

Besides, physical properties of snacks such as tasty (Almajwal, 2016) and cheap or affordable (Zenk et al., 2014) are other factors that enhanced snacking activity. These findings suggest that a good-tasting snack can influence intrapersonal preferences such as taste and sensory perception in snack consumptions (Xiang & Lian, 2021). According to Forbes, Kahiya and Balderstone (2016), taste was the most frequently evaluated characteristics when a consumer wants to buy and eat a snack-type food followed by price, convenience and brand. Snacks with cheap or inexpensive price highly influence consumers' choice was also reported by other study with specific features of energy-dense and high palatability (Hauser, Nussbeck & Jonas, 2013).

Limitations and strength

Full access to databases aids in acquiring the important data from the literatures without missing any potential or relevant studies. However, there were few databases that cannot be accessed

making it as one of identified limitation in this study. The strength of this study is the application of PRISMA-ScR as the core methodology in this review; which is a well-recognized method and utilized globally in performing scoping review systematically. Consequently, this method is able to provide best quality of research conduct to map evidence based on a topic and point out several elements including main concepts, theories, sources and knowledge gaps.

Conclusion

The types of snacks associated with stress among adults were highly palatable and energy dense, followed by sweet and savory. Healthier option was the least preferred. Majority of the identified studies demonstrated significant positive association between snack intakes and stress among adults. The contributing factors play a direct or indirect role in determining association between snack intakes during periods of stress. This review findings will be useful in providing an insight for health promoting approach such as through law legislation, health campaigns or program and dietary intervention or any related strategies to improving population's health in general with regards to dietary intake emphasizing snacking consumption.

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Appendix 1

Research findings of included studies (n=12)

No	Title, author, year	Setting, age, sample size, gender	Study design	Research Findings		
				Preferences and choices of snack intakes during periods of stress	The relationship between snack intakes and stress among adults	Contributing factors to snack
1	Perceived effects of stress on food choice. (Oliver & Wardle, 1999).	212 undergraduate students (n=63 male, n=149 female) from three colleges in the Universities of London and Thames Valley	Cross-sectional study	Sweet snack – Sweets and chocolate Savory snacks Highly palatable and energy dense – Cakes and biscuits	Women being more likely to report hyperphagia for sweets and chocolate, $\chi^2(2) = 10.9$, $p < 0.01$. A brief questionnaire regarding self-induced eating. Questions covered the perceived influence of stress on (1) overall amount of food eaten (2) amount of snacking, and (3) amount eaten of each of a list of specific types of foods	Not assessed
2	Perceived changes in food intake in response to stress: The role of conscientious ness	Psychology undergraduate students (n=155 female) from two British universities participated in the study	Mixed-method study	Sweet snacks – Sweets and chocolate Savory snacks Highly palatable and energy dense	Significantly higher scores were found for perceived changes in between-meal snacking ($t(130) = 3.26$, $p < 0.01$) and each of its constituent food groups during the stressful	Not assessed

	(O'Connor & O'Connor, 2004).			snacks foods – Biscuits/cakes	period compared to the non- stressful period. (1) Perceptions of changes in food intake were recorded in dietary diary (2) Emotional distress was assessed using the 30-item General Health Questionnaire (GHQ; Goldberg & Williams, 1988) (3) Perceived stress was assessed using the 14-item Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983)	
3	Neighborhood food environment role in modifying psychosocial stress–diet (Zenk et al., 2013).	460 adults (no information on gender) age ≥25 years residing in housing units three areas of Detroit	Cross-sectional study	Sweet snacks – Ice cream, pudding, chocolate candy, and other candy Sugar-sweetened beverages – Regular soda, Kool-Aid, Hi-C, and sugar-sweetened fruit drink Salty snacks – Chips, crackers, nuts, and French fries	Neither chronic stress nor major life events was associated with snack food intake (1) Daily frequency of snack food intake was calculated using 17 items reported on the 2005 Block semi-quantitative food frequency questionnaire (2) Two types of psychosocial stress: chronic stress and major	Availability of -Large grocery stores -Small grocery stores -Convenience stores -Fast food restaurants

				Highly palatable and energy dense – Cake, muffins/biscuit/croissant, cookies, donuts and pie	life events were measured (a) Chronic stress; An index of chronic stress is created from five sub-scales: neighborhood physical environment, neighborhood social environment, safety stress, everyday unfair treatment, and financial vulnerability (b) Major life events; Number of major life events was calculated as the sum of nine items assessing whether an event occurred within the past 12 months	
4	Ecological momentary assessment of environmental and personal factors and snack food intake in African American women (Zenk et al., 2014)	African American adults (n=100 female) aged 25 to 65 living in metropolitan Chicago, Illinois.	Cross-sectional study	Sweet snacks – Sweetened baked goods, chocolate, candy, ice cream and frozen dessert Salty snacks –French fries Highly palatable and energy dense – Cookies and fried side dish	Women who reported on average more stressful events (O.R. 1.16, 95% C.I. 1.06, 1.28), more frequent daily hassles (O.R. 1.20, 95% C.I. 1.07, 1.35), and more positive affect (O.R. 1.18, 95% C.I. 1.03, 1.36), relative to other women, were more likely to consume snack foods (1) Intake of snack foods was measured based on five of these categories:	Being near a restaurant, convenience store, bakery, or candy store (15.5%), inexpensive food (12.1%), and being near a grocery store (4.9%) were less frequently reported as facilitators.

					cookies or sweetened baked goods, chocolate or candy, ice cream or frozen dessert, salty snacks, and French fries or other fried side dish. These categories were adapted from the Dietary Screener Questionnaire. (2) Stress – negative effect were measured at each signal with an adapted short-form Positive and Negative Affect Schedule (PANAS)	
5	Randomized Test of an Implementation Intention-Based Tool to Reduce Stress-Induced Eating (O'connor, Armitage & Ferguson, 2015)	Adults (n=202 female) age 18 to 60 were recruited from a large university in the UK	Cross-sectional study	Sweet snacks – Chocolate Savory snack – Crisps Highly palatable and energy dense – Cakes. Fruit – Banana, apple, and dried fruit	Daily stressors were significantly positively associated with unhealthy snacking (β=0.08, $p<0.05$) but not healthy snacks (β=0.02, ns) in the entire sample (1) Online Daily Diary to report stressor and snack intakes (2) Stress assessment – Stress Management Support (SMS) Tool	Not assessed
6	Stress, shift duty, and eating behavior among nurses	A sample of non-Saudi nurses (n=395 female) with age range <30 to >50 years old from two major	Cross-sectional study	Snacks (no information on preferences and choices)	- For all eating behaviour styles, stress influenced the amount of food nurses consumed, but	-Taste -Work performance -Compensate reduced food

	in Central Saudi Arabia (Almajwal, 2016)	hospitals in Riyadh, Kingdom of Saudi Arabia		Highly palatable and energy dense – Fast foods Fruits and vegetables (no information on choices)	significantly more under restrained eating. -Under the restrained eating style, a significantly higher percentage of nurses (often and almost every day) reported eating more fast food, snacks, and binging, while fruits and vegetables were the least likely to be eaten under stress (2 and fewer than 2 servings) (1) The Dutch Eating Behavior Questionnaire (DEBQ) is a 33-item self-reported questionnaire to measure eating behavior. (2) The perceived stress scale (PSS) containing 4 items	intake during main meal before duty
7	Snacking and diet quality are associated with the coping strategies used by a socioeconomically diverse urban cohort of African-	2,177 socioeconomically diverse African-American and white adults (n=553 African-American male, n=392 white male, n= female, n=707 African-American female, n=525 white female) age 30 to 64 years	Cross-sectional study	African-American man; -Salty snack – Potato chips, crackers, popcorn and pretzels Both racial groups and gender;	Adjusting for perceived stress and selected demographic characteristics, emotion-focused coping strategies were associated with greater energy intakes from snacks (P=0.020) (1) Snack intakes – The US Department of	Not assessed

	American and white adults (Kuczmarski et al., 2017)	who resided in Baltimore, MD		-Sweets snacks/ beverages – Soft drinks Grain-based dessert snacks (high palatability and energy) – Cookies, cake, pastry, and doughnuts.	Agriculture computerized Automated Multiple Pass Method was used to collect both 24-hour dietary recalls (2) Perceived stress was measured with the 4-item Perceived Stress Scale by Cohen and colleagues	
8	Negative affective stress reactivity: The dampening effect of snacking. Stress and Health (Wouters et al., 2018)	269 adults (n=72 male, n=197 female) age 20 to 50 years old in Netherland.	Cross-sectional study	Sweet snack - Apple pie, cake, biscuit, and coffee with milk and sugar Highly palatable and energy dense – Cheesecake and wiener mélange	A significant interaction between momentary subjective appraisal of stress and snacking (β [SE] = −.05 [.01], p = <.01) in association with NA Stress, NA, and between-meal snack intake were assessed in daily life with the experience sampling method (ESM) (1) Snack intake is recorded using the *Snackimpuls* app (2) NA was assessed using the Positive Affect and Negative Affect Schedule (PANAS) and previous ESM studies	Not assessed
9	Food selection under stress	400 undergraduate students (n=200 male,	Cross-sectional study	Female students;	Females (78.0%) reported preferring snack-type	-Easy to prepare

	among undergraduate students in Riyadh, Saudi Arabia. (Mohamed, Mahfouz & Badr, 2020)	n=200 female) age 18 to 29 years old studying at the College of Applied Medical Sciences (CAMS) in Riyadh, Saudi Arabia (SA)		-High-dense calorie and sweet snacks – Sweets, chocolate, ice cream, and cookies.	food options significantly more than males (20.5%) did when stressed (Z=10.5; p<0.001). (1) Self-reported dietary intake was assessed using a 7-day food frequency questionnaire (FFQ) (2) Stress was assessed using the PSS-10 questionnaire	-As coping mechanism (to increase attention and memory)
10	Piece of cake: Coping with COVID-19 (Chee et al., 2020)	665 adults (n=155 male, n=510 female) 18 years old or older living in Canada or the United States	Cross-sectional study	(1) Sweet – Candy, including chocolate, candy bars, jelly beans, hard candies, and gummies, low-fat or non-fat frozen desserts; regular ice cream and milkshakes. (2) Salty – Low-fat or non-fat potato chips, tortilla chips, and corn chips; regular potato chips, tortilla chips, corn chips, and puff (3) Highly palatable and energy dense – Doughnuts, pop tarts, croissants, pastries; cookies,	Younger participants were more likely to engage in salty (r=−0.17, p<0.001) and sweet snacking (r=−0.13, p=0.001), as were males (salty, r=0.22, p<0.001; sweet, r=0.12, p=0.003) and those living in the United States (salty, r = 0.15, p<0.001; sweet, r=0.11, p=0.004). Conversely, compared to those living with others (with or without children) were more likely to snack on salty foods compared to those living without other adults (η2=0.012, F(3676) = 2.85, p=0.037).	-Eating to cope with negative effect

				brownies, pies, cakes	(1) Beverage and Snack Questionnaire 2 (BSQ2) emphasizing 14 types of beverages and 10 types of snacks on a seven-point rating scale. (2) Stress appraisals - The 28-question Stress Appraisal Measure (SAM) on a five-point scale ranging from 1 (not at all) to 5 (extremely).	
11	Relationship between sweet food intake and stress among college students in Seoul and Gyeonggi areas (Kim, Lee & Song, 2021).	760 college students (n=370 male, n=390 female) (aged 18–28 years) in Seoul and Gyeonggi areas	Cross-sectional study	In female students: (1) Sweet snack – Sport drinks, frappe, ice cream, honey bread, waffles, and drinking yogurt. (2) Highly palatable and energy dense – Biscuits and cookies In male students: (1) Sweet snack – chocolate-containing snacks, flavored milk, drinking yogurt, yogurt, and soymilk	In the state of factor 1 (worries, fatigue and tension), the intake of biscuits and cookies was significantly higher in females ($p < 0.01$) and the intake of chocolate-containing snacks was significantly higher in males ($p < 0.05$) compared to those in the state factor 2 (depression and frustration) and factor 3 (anger and aggression). (1) The intake of sweet foods was measured by answering the number of intakes per month and	Not assessed

					the amount of food per each intake for 24 items (2) The stress recognition rate was measured by referring to the stress measurement tool for Korea National Health and Nutrition Examination Survey developed in 2010	
12	The influence of COVID-19-related stress on food motivation (Smith et al., 2021).	429 adults (n=157 male, n=272 female), aged 18 to 67 years old at residents of New Jersey, Delaware, the District of Columbia, and Illinois, where lockdown orders were in place on the date of survey distribution. Then, the residents of California, Maine, Michigan, Nebraska, New Mexico, New York, Oregon, Pennsylvania, Tennessee, and Washington; these states had regional lockdowns	Cross-sectional study	Sweet snacks – Ice cream, cookie and brownie Fruit – Watermelon, strawberries, apple, banana. Savory snacks – French fries, Doritos and Cheetos	The desired portion size of the preferred food selected by the participants did not differ by stress level for sweets ($x^2(12)=16.78$, $p=0.158$) or savory snacks ($x^2(12)=13.17$, $p=0.357$) (1) Food frequency questionnaires and U.S Department of Agriculture (USDA) dietary recommendation material (2) Measures of reported stress (a) General stress; Participants rated their level of stress "right now" and "before the COVID crisis began" on a scale from 1 to 10, where 1 represented "not	Food motivation: - Willingness to wait. - Willingness to pay. -Willingness to work.

		at all stressed" and 10 represented "extremely stressed" (b) A 16-item 'COVID-stress index in which individuals responded to the question 'How stressed are you about the following in relation to the COVID crisis?' for multiple pandemic-related factors including finances and availability of resources

Appendix 2

Summary of thematic analysis results

Theme	List of food(s)	Author(s) and year
Highly palatable and energy dense	Cookies	(Zenk et al., 2013[a]; Zenk et al., 2014; Kuczmarski et al., 2017; Mohamed, Mahfouz & Badr, 2020; Chee et al., 2020; Kim, Lee & Song, 2021)
	Biscuits	(Oliver & Wardle, 1999; O'Connor & O'Connor, 2004; Zenk et al., 2013[a]; Kim, Lee & Song, 2021)
	Cakes	(O'connor, Armitage & Ferguson, 2015; Kuczmarski et al., 2017; Chee et al., 2020)
	Doughnuts	(Zenk et al., 2013[a]; Kuczmarski et al., 2017; Chee et al., 2020)
	Pie	(Zenk et al., 2013[a]; Wouters et al., 2018; Chee et al., 2020)
	Croissants	(Zenk et al., 2013[a]; Chee et al., 2020)
	Pastry	(Kuczmarski et al., 2017; Chee et al., 2020)
	Muffins	(Zenk et al., 2013) [a]
	Fried side dish	(Zenk et al., 2014)
	Fast foods	(Almajwal, 2016)
	Pop tarts and brownies	(Chee et al., 2020)
	Cheesecake and wiener mélange	(Wouters et al., 2018)
Sweet	Chocolate	(Oliver & Wardle, 1999; O'Connor & O'Connor, 2004; Zenk et al., 2014; O'connor, Armitage & Ferguson, 2015; Mohamed, Mahfouz & Badr, 2020; Chee et al., 2020)
	Ice cream	(Zenk et al., 2013[a]; Zenk et al., 2014; Mohamed, Mahfouz & Badr, 2020; Chee et al., 2020; Kim, Lee & Song, 2021; Smith et al., 2021[a])
	Sweetened beverages	(Zenk et al., 2013[a]; Kuczmarski et al., 2017; Wouters et al., 2018; Chee et al., 2020; Kim, Lee & Song, 2021)
	Sweets	(Oliver & Wardle, 1999; O'Connor & O'Connor, 2004; Mohamed, Mahfouz & Badr, 2020)
	Candy	(Zenk et al., 2013[a]; Zenk et al., 2014; Chee et al., 2020)
	Frozen dessert	(Zenk et al., 2014; Chee et al., 2020)
	Pudding	(Zenk et al., 2013)[a]
Savory	French fries	(Zenk et al., 2013[a]; Zenk et al., 2014; Smith et al., 2021[a])
	Chips	(Zenk et al., 2013[a]; Kuczmarski et al., 2017; Chee et al., 2020)
	Crisps	(O'connor, Armitage & Ferguson, 2015)
	Popcorn and pretzels	(Kuczmarski et al., 2017)
	Crackers	(Zenk et al., 2013[a]; Kuczmarski et al., 2017)
	Nuts	(Zenk et al., 2013)[a]
	Doritos and Cheetos	(Smith et al., 2021)[a]
Healthier option	Watermelon, banana, apple and strawberries	(Smith et al., 2021)[a]
	Fruits and vegetables	(Almajwal, 2016)[b]
	Banana, apple and dried fruit	(O'connor, Armitage & Ferguson, 2015)

[a] no association with stress

[b] negative association with stress