Title: Grazing, motives to eat palatable foods, and fat and sugar consumption: An exploratory investigation.

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Abstract:

Purpose: Contemporary research investigating obesity has focused on grazing (i.e., an uncontrolled and repetitive consumption of small amounts of food). Meanwhile, the association between grazing and motivations or actual consumption of energy-dense foods as explanatory factors has not been explored in current weight regulation research.

Methods: The association between grazing, *motivations to eat palatable foods* and *fat and sugar consumption* were explored in a cross-sectional study with university students (n=318) who were recruited to participate in an online study.

Results: Results indicated that both motivations to eat palatable foods and fat and sugar consumption were positively related to grazing, but only motivations to eat palatable foods explained the positive relationship between grazing and current weight.

Conclusion: Motivations to eat palatable foods appears to be more explanatory of grazing in the sphere of weight regulation and grazing than the actual consumption of fat and sugar. Possible explanations and future directions are discussed.

Level V: Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Keywords: grazing; motivations to eat palatable foods; obesity; fat consumption; sugar consumption

Introduction

Research focusing on the general population and students has indicated a positive association between grazing and weight status (Saunders, 2004; cf. Holzner & Szabo, 2014; Lane & Szabo, 2013). Grazing is defined in eating literature as the uncontrolled and repetitive eating of small amounts of food. While the loss of control over eating in grazing is questionable (Fairburn, 2008), and similarly the clinical and disordered nature of grazing has been debated (Conceição et al., 2014; Lane & Szabo, 2015), the distinct behaviour of eating smaller amounts of food repetitively has been recognised as an important eating behaviour (e.g., Lane & Szabo, 2013; Saunders, 1999; Saunders, 2004) which adds to the aetiology of obesity, and warrants more investigation. This research aimed to investigate the nature of grazing, whereby the association to fat and sugar consumption, as well as motivations to eat palatable foods may well be directive of future research in the field.

Associations of grazing to obesity and weight regulation has been mostly explored in specialised populations (such as bariatric surgery patients), which represents most of the literature presented around grazing. A recent systematic review (see Parker & Brennan, 2015) identified seven studies reporting grazing as an outcome, which is quite insignificant considering the potential impact to obesity treatment and interventions, and qualitative and quantitative accounts of grazing for samples of participants ranged from 26-60% (Colles, Dixon & O'Brien, 2008; Saunders, 1999; see also Opolski, Chur-Hansen & Wittert, 2015). However, whether grazing relates to motivations to eat palatable foods, and the potential consumption of palatable foods that are calorie-dense, high in sugar and fat has not been explored in the literature.

Typical diets in developed counties are characterised by energy-dense food, high in saturated fat and/or sugars (Drewnowski & Popkin, 1997; Hu et al., 2000; Popkin, 2006). This preferred consumption of foods contributes to the growing problem of obesity and adds to the aetiology of associated chronic conditions such as diabetes (Mather et al., 2008). A report by the World Health Organization (2003) recommended reducing the consumption of energy-dense foods as a primary goal for the prevention of chronic diseases that are eating related. Most people, however, fail to adhere to the dietary recommendations, and supplementary sugars that exist in everyday foods contribute greatly to this problem (Gidding et al., 2006; McGuire, 2011; Ervin, Kit, Carroll & Ogden, 2012; Park, Blanck, Sherry, Brener & O'Toole, 2012). A recent meta-analysis and systematic review that examined results from sixty randomized controlled trials and prospective cohort studies concluded that increased dietary sugar intake was associated with increased body weight, while reduced dietary sugar intake was associated with decreased body weight (TeMorenga, Mallard, & Mann, 2012). However, the association between readily available calorie-dense foods and grazing is unknown and there is little knowledge or understanding around what motivates people to graze on palatable and energy-dense foods and grazing.

Grazing may constitute a different and separate overeating behaviour from other overeating behaviours such as binge eating and therefore may indicate separate interventions and psychoeducational material focused specifically on this behaviour to aid weight regulation.

It is well documented that there are frequently other reasons for the consumption of calorie-dense food apart from hunger. Recently, Burgess, Turan, Lokken, Morse and Boggiano, (2014) proposed a Palatable Eating Motives Scale (PEMS), which explores non-hunger driven motives such as *coping*, *reward enhancement*, *social* and *conformity* motives. Results show that *coping* is associated with higher BMI in weight regulating and student samples (Boggiano et al., 2014; Burgess et al., 2014). Also, an increase or decrease in *coping* predicted future weight gain or loss in a longitudinal study (Boggiano et al., 2015). Knowing more about the motives or drives for eating these foods may enable further understandings around grazing, and assist in intervention development for obesity and bariatric surgery. For example, Lane and Szabo (2013) found an association between emotional eating and grazing; understanding which foods are consumed when repetitively consuming small amounts to cope with emotions may add greater understanding as to why grazing is particularly detrimental to weight regulation. Also, while there is an association between *coping*, *reward enhancement*, and *conformity* motives and binge-eating severity (Boggiano et al., 2014); there is also an association between binge eating disorder and symptomatology with grazing (Lane & Szabo, 2013). While binge eating is considered separate from grazing, the motives and actual consumption of palatable foods may present a similar complex relationship with energy dense foods. Exploring the association between consumption and motives to eat palatable foods with grazing will add more to our knowledge, and give an indication of the severity of grazing in both clinical and non-clinical settings. According the previous literature, we expect both motivations to eat palatable foods and fat and sugar consumption to positively relate to grazing, and to explain the positive relationship between grazing and current weight.

Methods

Participants

Three hundred and eighteen participants were recruited via volunteer sampling. All participants were students at one West Midlands University. Students received online invitations to take part in a study investigating eating patterns. Individuals were excluded if they were currently taking any medication for long-term conditions and/or if there was any diagnosis of eating disorders in the past 12 months. After exclusions, the final sample included

25 males and 289 females. Participants (M_{age}=20.84, SD= 4.83; M_{BMI}=23.91, SD=5.55) were recruited on a voluntary basis and did not receive any benefits or rewards for taking part in this research. Seven percent of the sample were classed as underweight (<18.5), 62% of the sample were classed as normal weighted (18.5 to 24.9%), 18% of the sample were classed as overweight (25.0 to 29.9), 11% of the sample were classed as obese (30.0 to 39.9) and 2% of the sample were classed as morbidly obese (40+). The highest BMI within the sample was 50.70 and the lowest was 15.04. The ethnic breakdown of this sample was 68.2% White, 9.1% Pakistani, 6 % Mixed, 5.7% Black, 4.4% Indian, 1.9% Bangladeshi, 1.9% Chinese and 0.6% Arab (see Table 1).

(Please insert Table 1 Here)

Materials

Participant information form. In order to gather demographic information, participants were asked to report a range of questions related to their gender, age, socio-economic status, ethnicity, and frequency of smoking and exercise. Participants also reported their height and weight for BMI to be determined, the following formula was used to calculate BMI: weight in kg/height in m^2. To ensure participants were eligible to take part in the research, they were asked additional questions related to health status, medication, and the presence of eating disorders.

Dietary Fat and Free Sugars (DFFS; Francis & Stevenson, 2013). The DFFS was used to evaluate participants overall intake of foods high in saturated fat and sugar over the past 12 months. The DFFS consists of 26 items and sample items include 'Mince, beef or lamb, for example, in hamburgers, nachos or bolognaise' and 'Milk (full fat only), including milk drunk by itself or in cappuccinos, milkshakes, or hot chocolate etc'. On a 5-point Likert scale, responses range from 26 to 182. The present study produced an alpha of (a=.797) for the DFFS.

The Palatable Eating Motives Scale (PEMS; Boggiano et al., 2014). The PEMS consists of 19 items which assess motives for eating palatable but unhealthy foods for reasons other than hunger. On a 5-point Likert scale, responses range from 1 (never/almost never) to 5 (always/almost always) and scores range from 19 to 95. A variety of foods are listed (e.g., sweets like ice cream, chocolate, doughnuts, cookies, cake, candy, muffins, scones, fudge, brownies, and other desserts), with instructions stating for participants to think about times they have ate any of the listed foods, and for them to mark how often they have consumed the foods for the following reasons. Sample items include 'I consume these foods/drinks to forget my worries' and 'I consume these foods/drinks to get "high

like" or euphoric feelings'. The PEMS factors into four motives, alpha scores and descriptions for each motive are presented: coping motives (*a*=.831) include consuming the listed foods to help deal with negative states (e.g., to help with worry, depression or nervousness), reward enhancement motives (*a*=.805) include consuming the palatable foods and beverages in order to enhance a positive experience or emotion, because it is rewarding (e.g., because it is fun, or feels pleasant), social motives (*a* =.872) relate to eating the palatable foods or beverages for social reasons, (e.g., to enjoy a party or to be more sociable) and conformity motives (*a*=.822) pertain to eating the foods and drinks because of pressure by others (e.g., to fit in). The present study produced an alpha of (*a*=.922) for the PEMS.

Grazing Scale (Lane and Szabo, 2013). The Grazing Scale consists of 8 items which assess an individual's tendency to eat small amounts of food in an unplanned, repetitious, and uncontrolled manner. Responses range from 1 (rarely) to 4 (all of the time), and scores range from 8 to 32. Higher scores indicate higher levels of grazing. Sample items include 'Do you eat more or less continuously throughout the day or during extended parts of the day (e.g., all afternoon)?' and 'Do you find yourself taking extra helpings or picking at extra food once you've finished your main meal?'. The present study produced an alpha of (*a*=.880).

Please note that Item-Alpha values for all scales are displayed in the Supplementary Materials.

Procedure and Design

After being sent online invitations at a University in the UK, participants who wished to take part in the study were able to access a link which directed them to a participant information form. The participant information form included relevant study information including the researchers contact details. To ensure ethical adherence participants were directed to a consent form, and thereafter were directed to the study questionnaires and a demographic form. Once participants had completed the questionnaires and the demographic form they were directed to a debriefing form, which informed participants of the current investigation and also provided participants with the contact details of the researcher, for participants who wanted to withdraw or find out the results of the study. Ethical approval was granted by Birmingham City University's Research Ethics Committee and was assessed to ensure compliance to guidelines set by the British Psychological Society.

Statistical Analysis

SPSS was used to run cross-sectional relationships and the PROCESS macro for multilevel mediation and conditional process analysis was carried out using SPSS 22.0 for Windows (Hayes, 2012).

Results

Inter-correlations between grazing, sugar and fat intake, motives to eat palatable foods and BMI are presented in Table 2. Significant positive relationships were observed between BMI and motivations to eat palatable foods ($p<.01$), and grazing ($p<.01$); whilst a significant negative relationship was observed between BMI and sugar and fat intake ($p<.05$). Motivations to eat palatable foods displayed a significant positive relationship to grazing ($p<.01$), with there also being a significant positive relationship between grazing and fat and sugar intake ($p<.01$).

(Please insert Table 2 Here)

Inter-correlations between grazing, fat intake, sugar intake, and motives to eat palatable foods subscales, as well as BMI are presented in Table 2. Both BMI and grazing displayed significant positive relationships with all four subscales of the motives to eat palatable foods scale. No relationship was observed between sugar intake and motives to eat palatable foods, with fat intake only being positively correlated with the reward enhancement subscale ($p<.05$).

A chi-square test for independence (with Yates' Continuity Correction) indicated no significant association between sex and smoking status, $\chi2$ (1, N = 313) = .039, p = .844, phi =.011; as well as sex and exercise status, $\chi2$ (1, N = 314) = 2.644, p = .104, phi =.092 (see Table 3). In addition, a chi-square test for independence (with Yates' Continuity Correction) indicated no significant association between ethnicity and smoking status, $\chi2$ (8, N = 311) = 14.782, p = .064, phi =.218; as well as ethnicity and exercise status, $\chi2$ (8, N = 312) = 4.086, p = .849, phi =.114 (see Table 4). We used the PROCESS macro (Hayes, 2013, Model 4) to test the indirect effect (denoted as *ab*) of grazing on BMI via motivations to eat palatable foods (10,000 bootstrap samples). This analysis confirmed that the indirect effect of grazing on BMI via motivations to eat palatable foods was significant (*ab* = .05, *SE* = 0.02, 95% CI = 0.02 / 0.09). The direct effect was non-significant (*B* = 0.05, *SE* = 0.04, 95% CI = -0.04 / 0.13).

(Please insert Table 3&4 Here)

Discussion

The aim of this research was to explore the relationship between grazing, consumption and motives for consumption of energy-dense foods. As expected, grazing related significantly to higher fat and sugar consumption, and motives to eat such foods other than hunger. Similarly, all variables significantly related to higher BMI, apart from fat and sugar consumption, which surprisingly had an inverse significant relationship. Further investigation into the subscales revealed that *coping*, *reward enhancement*, social and *conformity* motives to eat palatable foods, as well as fat and sugar when calculated separately, positively related to grazing. When investigating against BMI, sugar consumption appeared to preserve the significance of negatively associating to weight status, while fat consumption did not relate to weight status. Motives of coping and conformity significantly and positively relate to weight status.

Findings are relatively consistent with past literature (Boggiano, 2016; Saunders, 2004; cf. Holzner & Szabo, 2014; Lane & Szabo, 2013). Discrepancy with the recent research conducted by Lane and Szabo (2014), where they did not identify a relationship between grazing and weight status may relate to the differing nature of educational institutions and examination frequencies, or a more culturally dissimilar student samples that could explain differences as suggested in other research (Molarius et al., 2009; Pike & Borovoy, 2004). Furthermore, our findings show a negative association between BMI and sugar consumption, which suggests a problematic eating pattern within the student population that is not obvious in this average weighed sample. Again, findings need to be replicated, as there may be a need for an intervention across university student sample, regardless of weight status and adiposity levels (Yahia, Achkar, Abdallah, & Rizk, 2008). A mediation effect was observed on grazing on BMI via motivations to eat palatable foods, which was not the case with fat and sugar consumption as originally expected.

The limitations of this research relate to the cross-sectional nature and student sample that restrict the causal instigations and generalisation of findings. However, this research proposes future directions that are relevant to grazing in clinical and non-clinical populations. Similar to the suggestions that Lane and Szabo (2014) made, we also suggest the utilisation of grazing evaluations in obesity treatments and further. Grazing, although not conclusive from our current data, may be the non-clinical amplification of energy-dense food consumption. Even for a student population of an average weight, increased consumption of fat and sugar may

be damaging in respect to cognitive decline and deficits in hippocampal-dependent learning and memory (Attuquayefio et al., 2016; Gibson, Barr & Jeanes, 2013). Our current research, including the present data, is exploring both clinical and non-clinical populations, and explores student, obesity and post-bariatric surgery populations for the potential development of associated multidisciplinary weight management.

Conflict of Interest: The authors declare that they have no conflict of interest.

Compliance with Ethical Standards: The study was approved by the Ethical Review Board of the University, and was in accordance with the ethical standards of the institutional and/or national research committee, and with the 1964 Helsinki Declaration and its later amendments. Informed written consent was obtained prior to the experiment. This article does not contain any studies with animals.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Data Availability: The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to public availability violating the consent that was given by research participants.

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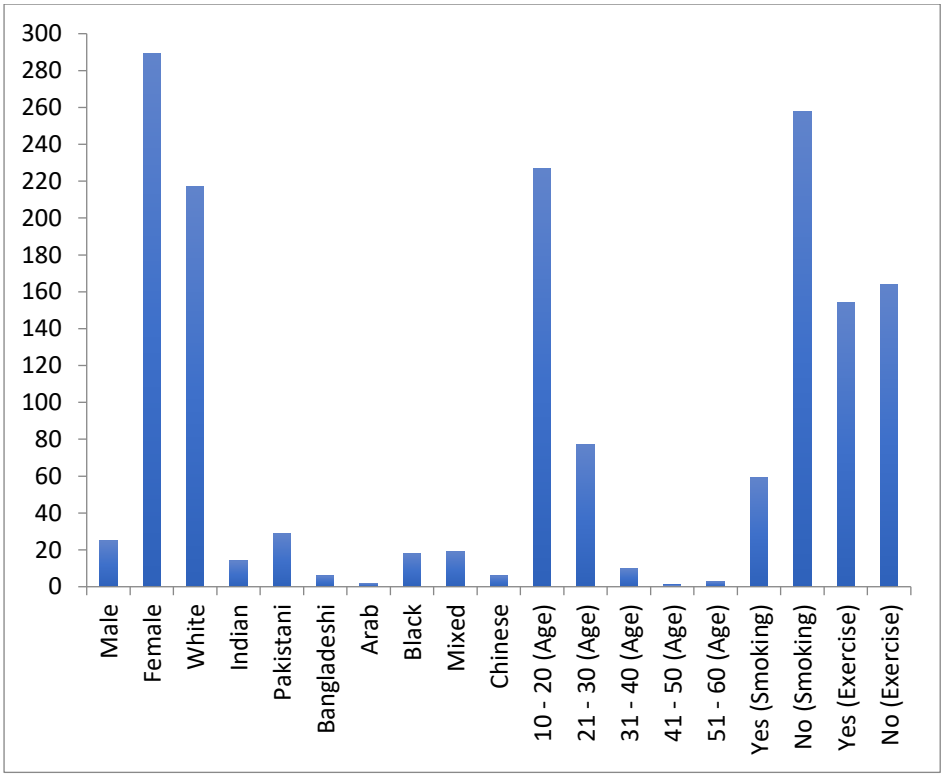

Figure – 1: Socio-demographic characteristics of sample

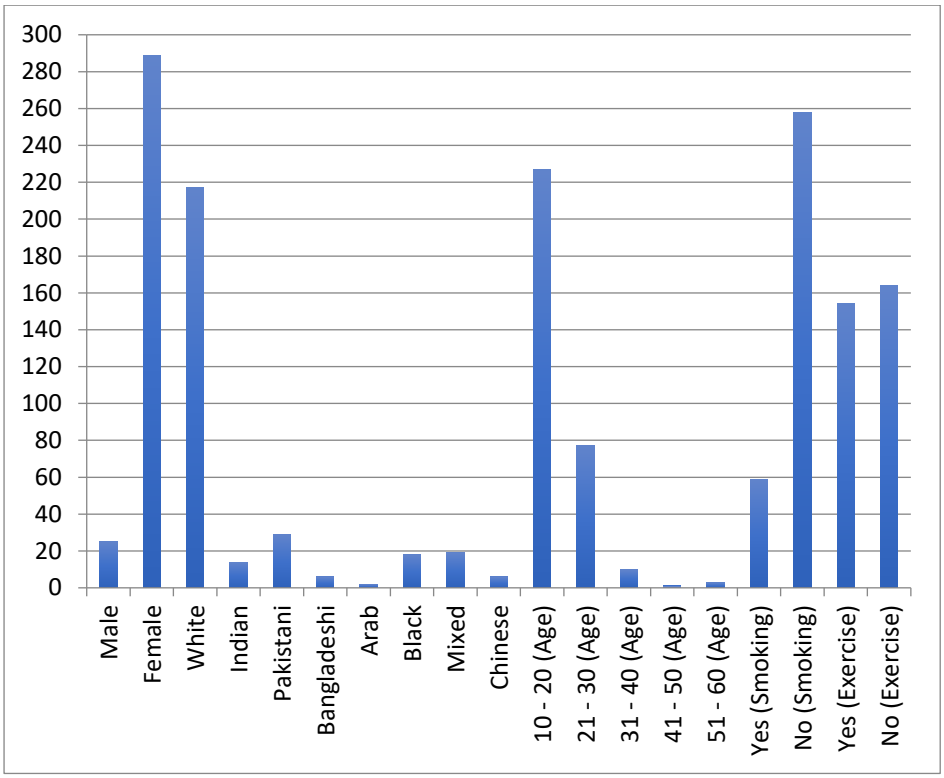

Figure – 1: Socio-demographic characteristics of sample

Table 1

Minimum values, Maximum values, Means, and Standard Deviations between grazing, sugar and fat intake, motives to eat palatable foods and BMI, as well as fat intake, sugar intake and motives to eat palatable foods subscales.

	N	*Minimum*	*Maximum*	*M*	*SD*
(1) BMI	312	15.04	50.70	23.91	5.55
(2) Grazing	315	1.00	40.00	19.42	8.76
(3) Sugar-Fat Total	298	32.00	101.00	57.36	11.77
(4) Fat Total	309	15.00	48.00	27.14	5.66
(5) Sugar Total	311	6.00	26.00	13.22	4.31
(6) PEMS	318	20.00	96.00	50.71	15.35
(7) P-S	318	5.00	25.00	14.44	5.15
(8) P-cp	318	3.00	20.00	10.54	4.40
(9) P-E	318	4.00	25.00	13.75	5.08
(10) P-Cn	318	4.00	24.00	9.90	4.25

Note: BMI = Body Mass Index, P-S = Palatable Eating Motives Social Subscale, P-Cp = Palatable Eating Motives Subscale, P-E = Palatable Eating Enhancement Subscale, P-Cn = Palatable Eating Motives Conformity Subscale

Table 2

Bivariate Correlations between grazing, sugar and fat intake, motives to eat palatable foods and BMI, age, sex, ethnicity, smoking frequency, alcohol frequency as well as fat intake, sugar intake and motives to eat palatable foods subscales.

	1	2	3	4	5	6	7	8	9	10	11	12
(1)BMI												
(2)Grazing	.153**											
(3)Sugar-Fat Total	-.147*	.195**										
(4) Fat Total	-.052	.197**	.833**									
(5) Sugar Total	-.155**	.140*	.784**	.481**								
(6)PEMS	.209**	.430**	.096	.083	.010							
(7) P-S	.119*	.240**	.056	.062	.000	.823**						
(8)P-cp	.285**	.477**	.085	.073	.005	.702**	.390**					
(9)P-E	.113*	.408**	.147*	.144*	.056	.811**	.574**	.466**				
(10)P-Cn	.155**	.234**	-.009	-.042	-.038	.742**	.533**	.386**	.413**			
(11)Age	.298**	.058	-.040	-.029	-.113*	.022	-.022	.134*	-.027	.035		
(12)Smoking Frequency	-.093	-.087	.024	-.048	.120	-.142	.048	-.207	-.165	-.053	.002	
(13)Exercise Frequency	.105	-.068	-.250**	-.197*	-.208**	-.056	-.131	-.029	-.071	.082	.239**	.128

Note: BMI= Body Mass Index, P-S = Palatable Eating Motives Social Subscale, P-Cp = Palatable Eating Motives Coping Subscale, P-E = Palatable Eating Motives Enhancement Subscale, P-Cn = Palatable Eating Motives Conformity Subscale.

**. Correlation is significant at the 0.01 level.

*. Correlation is significant at the 0.05 level.

Table 3
Frequencies between sex and smoking status, and sex and exercise status.

			Smoking Status		Exercise Status	
			Yes	No	Yes	No
Sex	Male	Count	5	20	16	9
			20.0%	80.0%	64.0%	36.0%
	Female	Count	53	235	136	153
			18.4%	81.6%	47.1%	52.9%

Table 4
Frequencies between ethnicity and smoking status, and ethnicity and exercise status.

			Exercise Status		Smoking Status	
			Yes	No	Yes	No
Ethnicity	Not disclosed	Count	1	0	0	1
			100.0%	0.0%	0.0%	100.0%
	White	Count	110	107	46	170
			50.7%	49.3%	21.3%	78.7%
	Indian	Count	6	8	0	14
			42.9%	57.1%	0.0%	100.0%
	Pakistani	Count	11	18	1	28
			37.9%	62.1%	3.4%	96.6%
	Bangladeshi	Count	2	4	1	5
			33.3%	66.7%	16.7%	83.3%
	Arab	Count	1	1	0	2
			50.0%	50.0%	0.0%	100.0%
	Black	Count	9	9	2	16
			50.0%	50.0%	11.1%	88.9%
	Mixed	Count	9	10	7	12
			47.4%	52.6%	36.8%	63.2%
	Chinese	Count	2	4	2	4
			33.3%	66.7%	33.3%	66.7%

Supplementary materials

Item-Total Statistics *Grazing*

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GR1	16.4495	63.216	.586	.871
GR2	17.0130	61.902	.644	.866
GR3	16.9577	61.361	.620	.868
GR4	16.8013	61.702	.611	.869
GR5	16.9870	59.797	.731	.857
GR6	16.6319	61.619	.614	.869
GR7	17.3062	59.305	.697	.860
GR8	17.5896	59.027	.658	.864

Item-Total Statistics *Fat and Sugar Consumption*

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
FS1	55.0940	130.974	.306	.797

FS2	55.4933	132.197	.248	.799
FS3	55.1477	130.988	.259	.799
FS4	55.6275	132.107	.288	.798
FS5	55.5604	132.133	.250	.799
FS6	55.7819	132.400	.228	.800
FS7	53.8121	128.214	.290	.798
FS8	54.8624	128.503	.306	.797
FS9	55.3792	130.580	.406	.794
FS10	54.5906	130.815	.228	.801
FS11	54.7819	126.548	.473	.789
FS12	54.9832	127.343	.329	.796
FS13	55.4161	126.560	.503	.789
FS14	55.0537	126.159	.481	.789
FS15	55.8456	130.602	.412	.794
FS16	54.3154	128.095	.334	.795
FS17	56.0503	133.368	.284	.798
FS18	55.4799	130.702	.261	.799
FS19	56.0101	132.656	.328	.797
FS20	55.7315	130.089	.314	.796
FS21	54.7383	123.204	.421	.791
FS22	54.7450	127.032	.260	.801
FS23	54.5738	121.848	.422	.791
FS24	54.7013	124.271	.398	.792
FS25	55.0134	129.104	.436	.792
FS26	55.1879	127.904	.297	.798

Item-Total Statistics *Motivations to Eat Palatable Foods*

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PFQ1	48.1458	224.160	.500	.920
PFQ2	47.8194	223.298	.499	.920
PFQ3	47.8403	218.434	.641	.917
PFQ4	47.8924	220.166	.559	.919
PFQ5	47.5972	217.816	.642	.917
PFQ6	47.4514	219.600	.571	.918
PFQ7	47.3681	220.575	.560	.919
PFQ8	48.8472	229.140	.407	.921
PFQ9	48.1076	218.117	.639	.917
PFQ10	48.6285	221.621	.609	.917
PFQ11	47.8924	214.717	.723	.915
PFQ12	48.7083	224.444	.567	.918
PFQ13	47.3646	218.846	.609	.917
PFQ14	47.9063	217.165	.643	.917
PFQ15	48.4479	220.959	.614	.917
PFQ16	47.2153	222.225	.523	.919
PFQ17	48.2569	217.467	.611	.917
PFQ18	47.6701	215.978	.656	.916
PFQ19	48.9896	228.658	.512	.920

PFQ20	48.6042	221.543	.587	.918