

## The Prevalence of Food Addiction Among a Sample of Saudi Adults and Its Association with Overweight and Obesity

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### ABSTRACT

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### KEYWORDS

*Food addiction, obesity, Saudi, eating behavior.*

Background: Obesity is highly prevalent in Saudi Arabia. It significantly contributes to morbidity and mortality among Saudi population. Food addiction has received a lot of attention due to the increasing prevalence of obesity, which is directly related to over consumption. To our knowledge; no study has explored addiction to food among the Saudi.

Objectives: To investigate the existence of food addiction in Saudi Arabian adults; and how it is associated with weight status; and other co-factors.

Design: A cross-sectional study.

Setting: healthy Saudi adults who volunteered to participate in an online survey (<http://www.surveymonkey.com/>), Saudi Arabia.

Study population and Methods: The survey had 1384 responses but only 1059 of those met the criteria of the study (26% men and 74% women) ranging in age from 18 to 59. The Yale Food Addiction Scale was used to diagnose food addiction.

Main Outcome Measures: Logistic regression analysis was used to determine the relationship between food addiction, overweight and obesity. Results: 10.9% of the entire study population diagnosed with food addiction. They were heavier by 13.8kgs. Those who were diagnosed with food addiction were 4.1%, 8.4% and 19.9 % among those who were healthy, overweight and obese respectively. The obese were 6.5 times more likely to have food addiction than those with normal weight. Food addiction found to be associated with people had a low income, were trying to lose weight, physically inactive, and watched TV, or used a phone for more than 5 hours each day.

Conclusion: Food addiction was found to exist in Saudi people and it is associated with those who were heavier. Thus, urgent intervention is needed to manage and overcome this problem.

Limitation: This is a cross-sectional study thus a longitudinal analysis is needed to evaluate the relationship between food addiction prevalence and weight status. The data was self-reported.

## انتشار إدمان الغذاء لدى عينة من البالغين السعوديين وارتباطها بالوزن الزائد والسمنة هيا الجدعاني<sup>1\*</sup> و لطيفة العبودي<sup>2</sup>

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### المستخلص

تعد السمنة من المشاكل الصحية المنتشرة في المملكة العربية السعودية، وتعد أحد الأسباب الرئيسية في الإصابة بالأمراض المزمنة وزيادة نسبة الوفيات بين السكان السعوديين. وتعد دراسة إدمان الغذاء من الأبحاث الحديثة التي تم تسليط الضوء عليها مؤخراً في العالم، وعلى الرغم من أن العديد من الباحثين قد بحثوا في العوامل الاجتماعية والديموغرافية المتعلقة بزيادة الوزن والسمنة لدى السكان السعوديين، إلا أن أياً منها لم يبحث في مشكلة إدمانه على الطعام.

الأهداف: هذه الدراسة هي الأولى تهدف الي البحث في مدي انتشار إدمان الغذاء في البالغين السعوديين في المملكة العربية السعودية على حسب معرفة المؤلفتين؛ وكيف يرتبط مع حالة الوزن. تصميم الدراسة: دراسة مستعرضة.

عينة البحث: البالغين السعوديين الأصحاء الذين يتطوعون للمشاركة في استطلاع عبر الإنترنت (<http://www.surveymonkey.com>) المملكة العربية السعودية.

طريقة الدراسة: كان لدى المسح 1384 استجابة ولكن 1059 فقط من هؤلاء استوفوا معايير الدراسة (26 ٪ من الرجال و 74 ٪ من النساء) تتراوح أعمارهم من 18 إلى 59 عاماً. تم استخدام نسخة مترجمة من الاستبانة العالمية لتحديد المصابين بالإدمان على الطعام. مقاييس النتائج الرئيسية: تم استخدام نسبة الأرجحية (OR) لتحديد العلاقة بين إدمان الغذاء وزيادة الوزن والسمنة.

النتائج: تم تشخيص 10.9% من المشاركين في الدراسة بأنهم لديهم إدمان الطعام، وكانوا أكثر وزناً بمتوسط 13.8 كجم مقارنة بذوي الوزن المثالي، كما كانت نسبة المصابين بالإدمان على الطعام 4.1 ٪ من ذوي الوزن المثالي، و 8.4 ٪ ممن يعانون من زيادة في الوزن، و 19.9 ٪ ممن يعانون من السمنة. كما إن الأشخاص الذي يعانون من السمنة أكثر عرضة بمعدل 6.5 مرة للإصابة بالمرض مقارنة بالأشخاص ذوي الأوزان المثالية. ووجد إن إدمان الطعام مرتبطاً بالأشخاص ذوي الدخل المنخفض و الذين يحاولون إنقاص الوزن و لا يمارسون أي نشاط بدني و يقضون وقتاً طويلاً في مشاهدة التلفزيون أو يستخدمون الهاتف لأكثر من 5 ساعات يومياً.

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### الكلمات الدالة

إدمان الطعام ، السمنة ، السعودية ، سلوك الأكل.

## Introduction

Obesity has exponentially increased globally over the past few decades. It is one of the most significant health concerns in Saudi Arabia, 75% of the Saudi population has been reported to be obese or overweight.(Al-Shehri, Moqbel, Al-Shahrani, Al-Khalidi, & Abu-Melha, 2013; Memish et al., 2014) Obesity increases the chances of adverse health effects, including reduced quality of life and wellbeing.(Luppino et al., 2010) Food addiction (FA) has received a lot of attention due to the increasing prevalence of obesity, which is directly related to over consumption.(Loxton & Tipman, 2017; Pursey, Stanwell, Gearhardt, Collins, & Burrows, 2014)

Although FA presents a new area of research, the concept has been investigated since the late 20th century. While no globally-accepted definition of FA has been determined, the term describes it as an abnormal pattern of excessive consumption of sugars, savory snacks and processed food products. (A. N. Gearhardt, W. R. Corbin, & K. D. Brownell, 2009; Adrian Meule & Gearhardt, 2014) Those who are addicted to food and those of drug abuse share certain similarities that supports the view that food additives trigger an addictive process. In the brain, addictive foods exploit the opiate and dopamine systems which are the pathways exploited by drugs. (Ashley N. Gearhardt, William R. Corbin, & Kelly D. Brownell, 2009; Hone-Blanchet & Fecteau, 2014; Nicole, Miriam, Bartley, & Mark, 2011; Pursey et al., 2014)

Individuals addicted to food, end up over eating in the face of severe negative effects such as stigmatization, heart diseases and diabetes, which would normally discourage this behavior.(Pedram et al., 2013; Pursey et al., 2014) Moreover, a recent systematic review concluded that FA may be contributed to adverse mental health, yet more research is required to prove this relationship. (Burrows, Kay-Lambkin, Pursey, Skinner, & Dayas, 2018) It also, links to greater weight. (Pursey et al., 2014)

Even though many studies have conducted to explore the relationship between FA and weight status, there are still controversial results about how FA relates to obesity, and only a few

researchers have studied the relationship between FA and weight status among general populations. (A. Meule & Kubler, 2012; Adrian Meule, Müller, Gearhardt, & Blechert, 2017; Pursey et al., 2014; Ziauddeen, Farooqi, & C Fletcher, 2012) Up to our knowledge, no study investigated this association in the Saudi population.

FA can be assessed using many tools including Food Craving Questionnaire, (Nijs, Franken, & Muris, 2007) Dutch Eating Behavior, (van Strien, Frijters, Bergers, & Defares, 1986) and the Yale Food Addiction Scale (YFAS).(A. N. Gearhardt et al., 2009) The YFAS is the most used tool by researchers in the behavioral, weight loss, psychophysiological, and dietary studies. It was developed in 2009 based on the eating traits derived from the Diagnostic and Statistical Manual of Mental Disorders. It is a standardized tool that can be used to dedicate addiction to food among population. It also shows reasonable adequate internal consistency ( $\alpha = 0.89$ ), convergent, discriminant and incremental validity (A. N. Gearhardt et al., 2009; Gearhardt et al., 2012). The YFAS captures core characteristics of addiction including tolerance, consumption of larger than usual amounts, failure in attempts to quit, continued behavior despite awareness of the consequences that are associated with addiction.(A. N. Gearhardt et al., 2009)

Therefore, the main aim of this study is to explore the prevalence of FA, using the YFAS, in a sample of Saudi adults with age 18 years old or older. In addition, to explore the relationship between FA and overweight and obese compared with those with normal weight status. Also, to investigate how FA is associated with co-factors.

## Methods and Study population

Saudi adults had participated in the study from December 2017 to March 2018. This is a cross-sectional study and administered standardized questionnaire was used to collect data.

The researchers used Survey Monkey (<http://www.surveymonkey.com/>) to disseminate the survey. The survey included the YFAS questionnaires; demographic; health status data; and anthropometric data.

Participants qualified for inclusion in the study if they were adults and the age of  $\geq 18$  years old and with Saudi Nationality. Pregnant women, non-Saudi adults, and underweight adults with a body mass index (BMI)  $< 18.5$  kg/m<sup>2</sup> were excluded from the study. The participants were recruited via notice board advertisements and posters on social media. Social networking websites were used to inform the public about the study. It was expected that the stated recruitment approach would enhance the representativeness of the sample. The selection of participants was based on voluntary participation. The study was approved by the Unit of Biomedical Research Ethics Committee at King Abdulaziz University, Jeddah, Saudi Arabia (reference number: 510-17).

### **The Yale Food Addiction Scale (YFAS)**

One section of the survey used in the study contained the YFAS questionnaire, which consisted of 25 items. For this study, the YFAS was translated into Arabic. This survey reviewed by three independent expertise in the area of food and nutrition and one reviewer from the linguistics faculty. The Arabic version of YFAS has been adapted and all reviewers have approved the final version. In addition, Cronbach Alpha test have conducted to assess the reliability of the survey and it was 0.96.

The YFAS retrospectively assesses 12-months of addictive food tendencies. The YFAS contains items that the respondents ranked using a 7-point Likert scale; scoring based on symptoms and diagnosis. (A. N. Gearhardt et al., 2009) The YFAS has two scoring outputs one is the total scores of these symptoms which ranged from zero to seven, and one is the diagnosis of FA if four or more of the symptoms meet the clinical signs of addiction. (A. N. Gearhardt et al., 2009)

### **Demographic and Self-reported Anthropometric Data**

Participants were asked to self-report their: age, gender, income, educational level, occupational and health status, smoking and marital status. The participants were also asked if they exercised (walking) consistently one to five times or more

per week. They were asked to report whether or not they tried to follow a diet to lose weight. They reported the screen hours of watching TV, using smart phone or/and computer.

Height in cm and weight in kg were self-reported. The BMI was calculated for each participant. The participants were then classified into different weight status groups based on the categories by the World Health Organization. Those with a BMI  $< 18.5$  kg/m<sup>2</sup> were categorized as underweight, a BMI between  $\leq 18.5$  kg/m<sup>2</sup> and  $\leq 24.99$  kg/m<sup>2</sup> was considered to be normal weight. A person with BMI  $\geq 25.00$ - $29.99$  kg/m<sup>2</sup> was categorized as overweight, and a person with a BMI  $\geq 30.00$  kg/m<sup>2</sup> was categorized as obese (World Health Organization, 2014).

### **Data Analysis**

Surveys with missing responses on the YFAS and BMI were excluded from the analysis. Descriptive statistics of the various variables such as FA, gender, presented as frequency and percentage. Also, description of the same variables described across BMI categories, those who were diagnosed as food addictive and those who are non-addictive groups. Logistic regression analysis was used to determine the relationship between FA, overweight and obesity. Participants that were classified as having normal weight were used as the reference group to compute the Odds Ratio (OR). Controlling for age, health status, income and gender. Statistical significance was defined as  $P\text{-value} \leq 0.05$ . Data were analyzed using the least version of IBM SPSS 24.0 software (USA).

### **Results**

A total of 1384 questionnaires were distributed, and the response rate was 85.9%. The total sample included 1059 adults (26% males; 74% females). In 130 of the cases, 3 participants were excluded because they were duplicates, 67 participants were excluded because they were underweight and 60 participants were excluded due to incomplete data about their height or YFAS.

A total of 1059 adults ranging in age from 18 to 59, with a mean age of  $(33.7 \pm 12)$  were enrolled in the study. More than two thirds (74%) of the cohort

were women, and 52% and 42.8% of the entire cohort were married and single, respectively. Of the cohort, 40.7% were employed and 33.8% were unemployed; 66.3% had a university certificate and 43% had an income less than 3000 Saudi Riyal (SR); 87% were healthy and 90.3% had never smoked; 48.7% had tried to lose weight (data not shown).

Table 1 shows the characteristic of the participants across food addiction categories. Of the entire cohort, 10.6% were diagnosed with FA. Those who

were food addictive were heavier by 13.8 kg (4.7 kg/m<sup>2</sup>) than those who did not meet those criteria of FA, Table 1. Table 2 present the demographic variables of the participants categorized by the presence of food addiction by BMI level. Those who were diagnosed with FA were 4.1%, 8.4% and 19.9 % among those who were healthy, overweight and obese respectively, Table 2.

**Table 1: Demographic and Anthropometric Characteristics of the Participants across all Food Addiction Categories (n=1059)**

Variable		FA	NFA
Food addiction a	n (%)	112 (10.6)	947 (89.4)
Weight	Mean (SD) Kg	84.3 (22.3)	70.5 (18.8)
BMI	Mean (SD) Kg/m <sup>2</sup>	31.6 (6.5)	26.8 (6.3)
Age a	18-20 years	18 (13.6)	114 (86.4)
	21 – 29 years	40 (11.8)	299 (88.2)
	30 – 39 years	28 (11.8)	210 (88.2)
	40 – 49 years	21 (11.2)	167 (88.8)
	50 – 59 years	5 (3)	157 (97)
Gender a	Male	32 (11.1)	256 (88.9)
	Female	80 (10.4)	691 (89.6)
Marital status a	Single	51 (12)	374 (88)
	Married	58 (10)	519 (90)
	Divorced	3 (5.2)	54 (94.8)
Occupational	Employee	40 (10.5)	339 (89.5)
Status a	Unemployed	68 (11.3)	532 (88.7)
	Retired	4 (5)	76 (95)
Educational	Basic education	25 (11.5)	191 (88.5)
Level a	University	77 (10.8)	635 (89.2)
	Postgraduate	12 (9.2)	119 (90.8)
Income a	Less than 3000 SR	57 (13.1)	378 (86.9)
	3000 – 5000 SR	14 (12)	102 (88)
	5000 – 10000 SR	27 (12.7)	185 (87.3)
	Above 10000 SR	18 (6)	278 (94)
Disease History a	Yes	17 (13.4)	110 (86.6)
	No	88 (10)	791 (90)
Smoking a	Yes	11 (10)	98 (90)
	No	101 (10.6)	849 (89.4)
BMI category a	Normal	16 (4.1)	375 (95.9)
	Overweight	27 (8.4)	296 (91.6)
	Obese	69 (20)	276 (80)
Physical Activity a	Yes	63 (8)	707 (92)
	No	49 (17)	240 (83)
Following Diet a	Yes	78 (14.4)	464 (85.6)

	No	34 (6.5)	483 (93.5)
Sleeping hours a	4 – 5 Hrs.	20 (10.6)	168 (89.4)
	6 – 7 Hrs.	48 (9)	489 (91)
	8 Hrs.	30 (12)	222 (88)
	More than 9 Hrs.	14 (17)	68 (83)
Screen Time a	The half-hour or less	3 (6.4)	44 (93.6)
	1 – 2 Hrs.	22 (8.6)	234 (91.4)
	3 – 4 Hrs.	28 (7.4)	355 (92.6)
	More than 5 Hrs.	59 (15.8)	314 (84.2)

FA: Food addicted    NFA: non-addicted    a: data presented as frequencies (%)

**Table 2:** Distribution of BMI Level among Demographic Variables and Food Addiction for each BMI Category for food addicted and Non -food addicted.

Body Mass Index							
Food addiction	n (%)a	Normal		Overweight		Obese	
Age	18 – 20 years	5 (6.4)	73 (93.6)	8 (24.2)	25 (75.8)	5 (23.8)	16 (76.2)
	21 – 29 years	6 (3.2)	180 (96.8)	7 (9.3)	68 (90.7)	27 (34.6)	51 (65.4)
	30 – 39 years	4 (6.3)	60 (93.7)	4 (5.1)	75 (94.9)	20 (21.1)	75 (78.9)
	40 – 49 years	1 (2.5)	39 (97.5)	7 (9.9)	64 (98.5)	13 (16.9)	64 (83.1)
	50 – 59 years	-	23 (100.0)	1 (1.5)	64 (98.5)	4 (5.4)	70 (94.6)
Gender	Male	4 (4.9)	77 (95.1)	4 (4.0)	95 (96.0)	24 (22.2)	84 (77.8)
	Female	12 (3.9)	298 (96.1)	23 (10.3)	201 (89.7)	45 (19.0)	192 (81.0)
Marital Status	Single	12 (5.1)	222 (94.9)	13 (13.4)	84 (86.6)	26 (27.7)	68 (72.3)
	Married	4 (2.8)	138 (97.2)	12 (6.1)	186 (93.9)	42 (17.7)	195 (82.3)
	Divorced	-	15 (100.0)	2 (7.1)	26 (92.9)	1 (7.1)	13 (92.9)
Occupational							
Status	Employee	5 (4.5)	107 (95.5)	5 (3.7)	129 (96.3)	30 (22.6)	103 (77.4)
	Unemployed	11 (4.1)	257 (95.9)	21 (13.3)	137 (86.7)	36 (20.7)	138 (79.3)
	Retired	-	11 (100.0)	1 (3.2)	30 (96.8)	3 (7.9)	35 (92.1)
Educational							
Level	Basic education	-	44 (100.0)	10 (12.3)	71 (87.7)	14 (15.6)	76 (84.4)
	University	15 (4.9)	292 (95.1)	15 (7.7)	179 (92.3)	47 (22.4)	163 (77.6)
	Postgraduate	1 (2.6)	38 (97.4)	2 (4.3)	45 (95.7)	8 (18.2)	36 (81.8)
Income	Less than 3000 SR	9 (4.2)	204 (95.8)	15 (14.9)	86 (85.1)	32 (26.9)	87 (73.1)
	3000 – 5000 SR	2 (6.1)	31 (93.9)	4 (10.0)	36 (90.0)	7 (17.1)	34 (82.9)
	5000 –10000 SR	5 (7.2)	64 (92.8)	3 (4.5)	64 (95.5)	18 (24.3)	56 (75.7)
	Above 10000 SR	-	73 (100.0)	5 (4.4)	109 (95.6)	12 (11.1)	96 (88.9)
Disease History	No	15 (4.2)	346 (95.8)	22 (8.2)	245 (91.8)	52 (20.5)	201 (79.5)
	Yes	-	36 (100.0)	8 (11)	65 (89)	20 (29)	49 (71)
Smoking	No	14 (4.0)	340 (96.0)	24 (8.4)	261 (91.6)	63 (20.3)	248 (79.7)
	Yes	2 (5.4)	35 (94.6)	3 (7.9)	35 (92.1)	6 (17.6)	28 (82.4)
Physical Activity	No	4 (4.9)	78 (95.1)	8 (11.0)	65 (89.0)	37 (27.6)	97 (72.4)
	Yes	12 (3.9)	297 (96.1)	19 (7.6)	231 (92.4)	32 (15.2)	179 (84.8)
Following Diet	No	6 (2.4)	243 (97.6)	8 (5.8)	131 (94.2)	20 (15.5)	109 (84.5)



	Yes	10 (7.0)	132 (93.0)	19 (10.3)	165 (89.7)	49 (22.7)	167 (77.3)
Sleeping Time	4 – 5 Hrs.	1 (1.8)	54 (98.2)	6 (9.2)	59 (90.8)	13 (19.1)	55 (80.9)
	6 – 7 Hrs.	5 (2.6)	190 (97.4)	10 (6.1)	154 (93.9)	33 (18.5)	145 (81.5)
	8 Hrs.	7 (6.9)	95 (93.1)	9 (12.3)	64 (87.7)	14 (18.2)	63 (81.8)
	More than 9 Hrs.	3 (7.7)	36 (92.3)	2 (9.5)	19 (90.5)	9 (40.9)	13 (59.1)
Screen Time	A half hour or less	-	10 (100.0)	1 (8.3)	11 (91.7)	2 (8.0)	23 (92.0)
	1 – 2 Hrs.	3 (3.6)	80 (96.4)	4 (5.3)	71 (94.7)	15 (15.3)	83 (84.7)
	3 – 4 Hrs.	4 (2.9)	133 (97.1)	7 (5.1)	129 (94.9)	17 (15.5)	93 (84.5)
	More than 5 Hrs.	9 (5.6)	152 (94.4)	15 (15.0)	85 (85.0)	35 (31.3)	77 (68.7)

FA: Food addicted      NFA: non-addicted      a: data presented as frequencies (%)

Table 3 presents the FA symptoms among participants and its relationship to BMI category. Among all the participants, the most common symptom was unsuccessful attempts to lose weight, Table3.

**Table 3:** Presents the food addiction symptoms among total participants and its relationship to BMI category

Food Addiction Symptoms. N(%)A	Total Sample (N=1059)	Bmi Category			P Value Chi-Square
		Normal Weight (N=391)	Overweight (N=323)	Obese (N=345)	
Loss Of Control	257(24.3)	87(22.1)	68(21.0)	107(31.0)	< 0.00*
Unsuccessful Attempts	797(75.2)	261(66.7)	244(75.8)	281(81.5)	< 0.00*
Much Time Spent To Obtain Food	306(28.9)	84(21.5)	80(24.7)	142(41.2)	< 0.00*
Give Up Important Activates	268(15.9)	43(10.9)	50(15.5)	112(23.6)	< 0.00*
Continue Despite Knowledge Of Adverse Consequences	346(32.7)	100(25.6)	89(27.5)	166(48.1)	< 0.00*
Tolerance	497(46.9)	153(39.1)	146(45.2)	201(58.5)	< 0.00*
Withdraw	148(14.0)	46(11.7)	37(11.5)	76(21.9)	< 0.00*
Clinically Significant Impairment	286(27.0)	79(20.2)	84(26.0)	128(37.1)	< 0.00*

\*=  $p \leq 0.05$       a: data presented as frequencies (%)

Table 4 presents information on the association between FA and overweight and obesity. In both the unadjusted and adjusted models, a significant association was found between FA diagnosis in the group classified as overweight and obese. The reference group consisted of normal weight participants. The OR for being FA among those who were overweight was 2.5 with a P-value of .007 in comparison to those who were normal weight in the adjusted model. Those who were obese were 6.5 times more likely to have an FA diagnosis than those with normal weight in the adjusted model.

**Table 4:** Odds Ratio (OR) of Food Addiction based on BMI Categories

Food Addiction	Univariate Model				Multivariate Model*			
	OR	CI 95%		P-Value	OR	CI 95%		P-Value
		lower	Upper			lower	Upper	
BMI				< 0.00*				< 0.00*
Normal	Reference Category				Reference Category			
Overweight	2.138	1.131	4.042	0.019*	2.503	2.341	4.756	0.007*
Obese	5.859	3.328	10.316	< 0.00*	6.551	3.438	11.215	< 0.00*

\*=  $p \leq 0.05$  OR: Odds Ratio CI: Confident Interval

Table 5 presents the correlation between FA and the confounder's age and income, following diet and physical activity. It found that low income,  $\geq 5$  hours of screen time, and physical inactivity were associated with greater chance to be food addictive. Those with an income less than 3000 SR had a higher probability of FA than those with an income exceeding 10,000 SR (OR= 2,67; CI: 1.18 to 6.05). Those who were physically inactive 2.098 times more likely to be addicted to food than those who were active. It also, found that those who spent  $\geq 5$  hours of screen time were 3.578 times more likely to be addictive to food than those who spent half an hour or less of screen time.

Table 5 presents the correlation between FA and the confounder's age and income, following diet and physical activity. It found that low income,  $\geq 5$  hours of screen time, and physical inactivity were associated with greater chance to be food addictive. Those with an income less than 3000 SR had a higher probability of FA than those with an income exceeding 10,000 SR (OR= 2,67; CI: 1.18 to 6.05). Those who were physically inactive 2.098 times more likely to be addicted to food than those who were active. It also, found that those who spent  $\geq 5$  hours of screen time were 3.578 times more likely to be addictive to food than those who spent half an hour or less of screen time.

**Table 5:** Unadjusted and Adjusted Odds ratio (OR) Estimates of Factors for each Genotype (Logistic Regression).

Variables	Univariate Model				Multivariate Model*			
	or	CI 95%		P-Value	OR	CI 95%		P-Value
		lower	Upper			lower	Upper	
Age				0.070				0.306
18-20	3.526	1.372	9.061	0.009*	3.572	0.969	13.169	0.056
21-29	3.350	1.396	8.036	0.007*	2.990	0.939	9.522	0.064
30-39	3.720	1.509	9.166	0.004*	2.936	1.012	8.514	0.047*
40-49	3.142	1.239	7.973	0.016*	2.964	1.046	8.397	0.041*
50-59#	1.0	-	-	-	1.0			-
Gender								
Male	1.140	0.745	1.744	0.546	1.261	0.767	2.074	0.361
Female#	1.0				1.0			
Education				0.853				0.710
Basic Edu	1.099	0.534	2.261	0.798	0.708	0.312	1.605	0.408



University	1.184	0.627	2.236	0.603	0.789	0.391	1.592	0.508
Postgraduate#	1.0				1.0			
Income	0.043*			0.043*				0.060
Less 3000	2.044	1.180	3.542	0.011*	2.672	1.181	6.045	0.018*
3000 – 5000	2.176	1.060	4.464	0.034*	2.661	1.159	6.112	0.021*
5000 – 10000	2.246	2.246	4.188	0.011*	2.264	1.144	4.479	0.019*
Above 10000#	1.0				1.0			
Disease History								
No#	1.0				1.0			
Yes	1.278	0.738	2.213	0.382	1.155	0.635	2.101	0.637
Smoking								
No#	1.0				1.0			
Yes	1.072	0.570	2.014	0.829	0.839	0.415	1.698	0.625
Following Diet								
No#	1.0				1.0			
Yes	2.590	1.718	3.904	0.000*	2.123	1.324	3.402	0.001*
Physical Activity								
No	2.253	1.525	3.329	0.000*	2.098	1.336	3.295	0.000*
Yes#	1.0				1.0			
Screen Time				0.003*				0.002*
Half or Less#	1.0				1.0			
1 – 2 Hrs	1.450	0.419	5.019	0.557	1.550	0.422	5.691	0.509
3 – 4 Hrs	1.247	0.367	4.238	0.724	1.553	0.432	5.581	0.500
5 & More	2.707	0.818	8.960	0.103	3.578	1.024	12.503	0.046*

Supplementation information shows correlation between FA and the confounders among the overweight and obese participants. The overweight participants were more likely to be addicted to food if they ranged in age from 18 to 20 and had an income of 3000 SR or less; they were also 7.8 times more likely to be addicted to food than the normal weight participants who ranged in age from 50 to 59. Those who were overweight with an income less than 3000 SR had a higher probability of FA than those who were normal weight with an income exceeding 10,000 SR. (data not shown)

Participants who were obese also had a higher likelihood of being addicted to food if they ranged in age from 20 and had an income of 3000 SR or less, and if they were also following a diet, not physically active and watched TV or used a smart phone for 5 hours or more each day.

Obese participants in the 20 to 29 year old age range were 12.8 times more likely to be addicted to food than normal weight participants in the 50 to 59 year old age range. Those who were obese

with an income of 3000 SR or less were 6.4 times more likely to be FA than those who were normal weight with an income exceeding 10,000 SR.(data not shown)

## Discussion

Overweight and obesity are highly prevalent in Saudi Arabia (Memish et al., 2014) and FA is considered to be the primary causes of weight gain in most of the population.(Lerma-Cabrera, Carvajal, & Lopez-Legarrea, 2016) Many researchers have investigated socio-demographic factors related to weight gain and obesity in the Saudi population (Al-Hazaa, Abahussain, Al-Sobayel, Qahwaji, & Musaiger, 2012; Al-Nozha et al., 2005; Khabaz et al., 2017; Mandoura et al., 2017; Memish et al., 2014), but none have explored addiction to food. To our knowledge, the present study is the first to explore FA assessed by the validated international tool (YFAS) in a Saudi sample.

Moreover, the present study investigated the relationship between FA, overweight, and obesity

among a sample of the general Saudi population of adults, 18 years of age or older in comparison with those with healthy weight. The main findings indicate that FA is present in a sample of the Saudi population. It found that 10.6% (n=119) of the entire sample (n=1059) were addicted to food. Meule et al. (2012) reported similar results; FA was observed in 10% of the 455 university students. Another study found that 14.7% of young adults were addictive to food.(Pursey, Collins, Stanwell, & Burrows, 2015) However, Pedram et al. (2013) found that only 5.4% of the 652 adults in their study were addicted to food.(Pedram et al., 2013)

The present study found that 4.1%, 8.4%, and 19.9% of the healthy, overweight, and obese participants, respectively were food addictive. This finding is similar to the results reported in a systematic review by Pursey et al. (2014), which concluded that the mean prevalence of FA was 19.9%; that prevalence was 11.1% and 24.2% for those classified as healthy and overweight/obese, respectively.(Pursey et al., 2014) They reported that the level of FA is higher among people who are heavier and obese. (Pursey et al., 2014) While Hauck et al. (2017) found that the FA prevalence was highest in people who were underweight and obese.(Hauck, Weiss, Schulte, Meule, & Ellrott, 2017) The results of our study found the prevalence of FA to be higher among the participants who were obese, then overweight in comparison with healthy weight.

There was a clear positive relationship between FA and the BMI categories. It found that those who were overweight were twice as likely to be addicted to food as those who were classified as normal weight in the adjustment models. Those who were obese found to be five times more likely to be diagnosed as food addictive in comparison to the healthy weight participants.

Another main finding was that those who were food addictive were heavier by  $13.8 \text{ kg} \pm 4.7 \text{ kg/m}^2$  than those who were not food addictive. This finding about the relationship between greater weight with FA is similar to the results from a study conducted on a group of Canadian adults, which reported that the participants with FA were heavier by  $11.7 \text{ kg}$  ( $4.9 \text{ kg/m}^2$ ) in comparison to

those who were not addicted to food.(Pedram et al., 2013) An Egypt-based study, which recruited 801 adolescents ranging in age from 11 to 18, did not find a relationship between FA and weight status; it found that 15.7% of the participants were diagnosed as being food addictive. (Ahmed & Sayed, 2017) A cohort study examined the relationship between FA and weight among 134,175 female nurses in the USA, middle-aged and older. The level of FA was higher among middle-aged women (8.4%) in comparison to older women (2.7%) as well as those who were heavier (a BMI  $\geq 35.0 \text{ kg/m}^2$ ) in comparison to those with BMI values ranging from  $18.5 \text{ kg/m}^2$  to  $22.9 \text{ kg/m}^2$ . (Flint et al., 2014)

The significant finding in the present study can explain the high prevalence of obesity among the Saudi population. Specialists should consider this when treating and preventing weight gain among Saudi people.

Moreover, the present study has investigated a new factor (Food addiction) that could be a reason for weight gain and the increase in obesity among Saudi adults. In Saudi Arabia, obesity significantly contributes to morbidity and mortality through type-2 diabetes, high cholesterol, and hypertension. (DeNicola, Aburizaiza, Siddique, Khwaja, & Carpenter, 2015) In the present study, the weight and height data were self-reported. However, this study's results for the incidence of obesity (29.1%) are consistent with the percentage (28.7%) obtained from nationally representative data of 10,735 adults, 15 years of age or older. (Memish et al., 2014) Thus, the results of this study might indicate a representative prevalence of obesity in a Saudi population; hence, the incidence of the FA could be generalized to that population.

This study explored the relationship between FA and a variety of co-factors, including age, gender, health status, smoking, and income. However, no correlations was observed between FA and health status. In this study, the FA prevalence was the same among males and females; no statistically significant difference was observed based on gender. However, these results should be confirmed through additional, future research. On the contrary, it found that the prevalence of FA was higher in females than it was in males.(Pursey

et al., 2014) For a cross-sectional analysis, 415 women and 237 men were recruited to evaluate the relationship between FA, as measured by YFAS. It found that 6.7% of females were addicted to food, while only 3% of males were addictive to food. (Pedram et al., 2013)

Moreover, it found low income,  $\geq 5$  hours of screen time, and physical inactivity were associated with greater chance to be food addictive. Among all the participants, the most common symptom was unsuccessful attempts to lose weight.

Due to the limitations of the financial support for this research, data obtained in the study recruited participants through an online survey. In addition, this is a cross-sectional study and thus a longitudinal analysis is needed to evaluate the relationship between FA prevalence and weight status with greater number of participants. The Anthropometric data of the participants were self-reported. The use of BMI based on self-reported data to evaluate the prevalence of overweight may leads to underestimation of the true prevalence. Therefore, the associations between FA and BMI categories should be interrupted with caution. Although, the study's results for the incidence of obesity are consistent with a National representative Study among Saudi adults.

## Conclusion

In conclusion, up to our knowledge, this is the first research to investigate FA and its association with overweight and obesity in comparison to normal weight in a sample of Saudi population. The study found that this problem exists in the selected sample and there is a positive association between addictive to food and weight status. Obese people were more likely to be food addictive. Also, people of socioeconomic status, those who spent more hours in using a smart phone or watching TV on a daily basis, those who have tried to lose weight (following a diet), and those who were not physically active, were more likely to be addicted to food. Moreover, people who of socioeconomic status and whose range in age from 18 to 20 are more likely to be victims of FA. Governmental policies, prevention and intervention strategies, and health care practices are recommended to

decreased weight problems and related health issues.

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